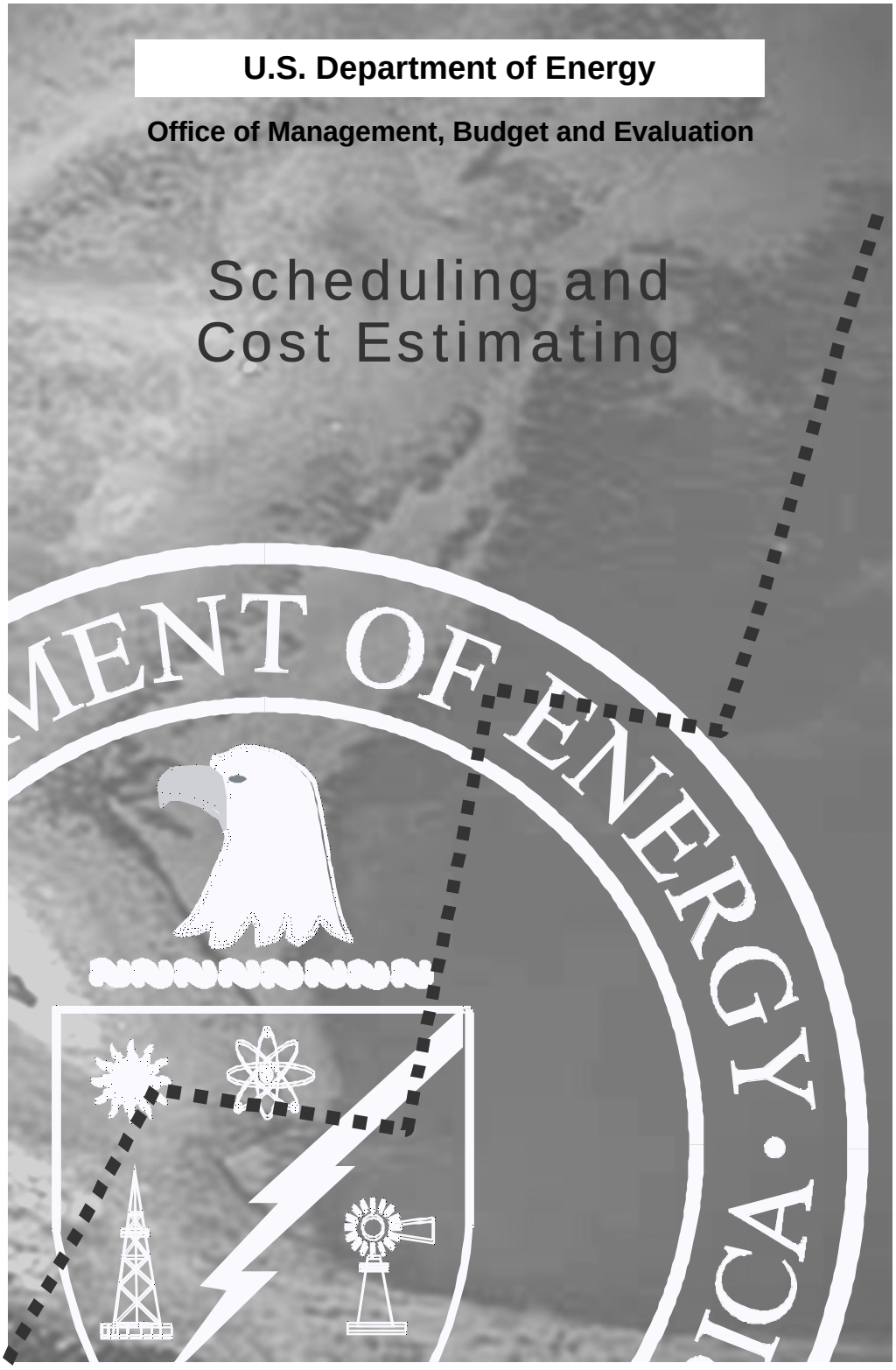

Initiated by: Office of Engineering and Construction Management

SCHEDULING AND COST ESTIMATING

1.0 OVERVIEW

Schedules are used to plan and depict practical, time-phased, hierarchical activities and events. They contain activities, logical relationships, milestones, duration, resource requirements and constraints. Scheduling is inextricably tied to the project's technical baseline and is essential to developing a cost estimate for the technical baseline.

Development of schedules is required early in the project formulation and conceptualization stage. A preliminary schedule range, including high-level milestones should be established before completion of the Initiation phase. A preliminary integrated project schedule should be in-place by completion of the Definition phase in support of Critical Decision-1, Approve Alternative Selection and Cost Range. Detailed preliminary network schedules including milestones and critical path should also be prepared and in place by completion of the Definition phase. A project summary network schedule reflecting the project's baseline schedule range is included in the final schedule baseline at Critical Decision-2, Approve Performance Baseline.

The integrated project schedule approved as part of the Critical Decision-2 submittal will include, but is not limited to, the following:

- Activities related to the project Work Breakdown Structure (WBS) and corresponding project cost estimates
- Activities defined at the detail level and logically sequenced to support, manage, and control the project
- A balance between the number of activities needed to define the project, and the ability of the control system to effectively maintain traceability of these activities
- Activity durations based on the number and availability of resources and, when appropriate, historical information
- The critical path and the capability to determine schedule float
- Milestones identified, defined, and related to baseline control levels
- Information organized, documented, and presented in a manner similar to the cost estimate, including basis, assumptions, exclusions, methodology, references, etc.

Schedule risk-based allowance should be included in project schedule and baselines to allow for future situations that can only be partially planned at the current project stage.

The bases for any schedule should be provided when the schedule is prepared. These bases should explain the purpose of the schedule, the assumptions upon which the schedule is based, and other facts pertinent to understanding the schedule.

Cost estimates are required at various points in a project's life cycle. Determination of estimating methodology and approach is based on the level and availability of scope definition and documentation, and the resources required for developing the cost estimate. Specific cost estimate requirements include:

- A planning estimate as part of the pre-acquisition phase.
- A preliminary cost estimate, including Life Cycle Cost analysis as part of the Conceptual Design Phase.
- A detailed (baseline range) cost estimate as part of the Preliminary Design.
- A Government estimate for construction contracts.
- Independent Cost Reviews (ICRs) or Independent Cost Estimates (ICE) for all capital asset projects prior to approval of Critical Decision-2, Approve Acquisition Performance Baseline.

ICRs are conducted on all projects typically at the point of baseline approval. ICRs are an essential project management tool. Such reviews may be required by Congress, DOE management, Headquarters Program Offices, or Field project management staff. The requiring office or agency provides requirements for such reviews.

ICEs are performed on capital asset acquisitions at appropriate points in the project life cycle. The Office of Engineering and Construction Management (OECM) works through appropriate contracting officers to establish contracts for ICEs. The ICEs are used to verify project cost estimates and support the Critical Decision-2 process in establishing project performance baselines. ICEs, however, are documented in formal reports submitted to the Secretarial Acquisition Executive/Acquisition Executive (SAE/AE) by OECM. ICEs may be performed on different projects and at other times. Each ICE is reconciled with the current Program Office estimate by the Project Director (PD).

For line item, general plant projects, and capital equipment projects, cost estimates address all costs associated with the project from conceptual design through project closeout. For Environmental Management projects, cost estimates address all costs associated with the defined project life cycle. Where appropriate, Environmental Management cost estimates also include startup, operating, and decommissioning costs. Cost estimate risk allowances should be included in project estimates and baselines to allow for future situations, e.g., "known unknowns." that can only be partially planned at the current stage. Allowances included in cost estimates are based on risk assessments. Estimates, their content and methodology should be consistent with the DOE "Cost Guide," Volume 6, dated December 7, 1994.

The initial basis for any cost estimate should be documented at the time the estimate is prepared. The basis should describe or reference the purpose of the project, the scope significant features and components, proposed methods of accomplishment, proposed project schedule, research and development requirements, special construction or operating procedures, site conditions, and any other pertinent factors or assumptions that may affect costs.

For the development and application of scheduling and cost-estimating methodologies, an integrated and disciplined approach is essential.

To achieve schedule and cost integration of all elements of the process, critical path activities and milestones are visible; disciplined status techniques are employed; change control is imposed on project scope, schedule, and cost at the appropriate time; and effective reporting procedures are developed and implemented.

Cost estimating methodology should be consistent with the project phase or degree of project definition. An appropriate activity-based cost-estimating methodology should be used (e.g., bottoms-up, parametric, estimating models, expert opinion, market quotations, etc.). The estimating methodology should be clearly specified along with assumptions made for determining the life cycle cost estimates.

2.0 SCHEDULING

Schedules are generally developed and presented in a hierarchical structure, with lower-level detailed schedules being traceable to higher-level schedules. Individual components or elements of work must be traceable from one schedule level to another to effectively portray consistency. Schedules are developed consistent with the structure of the WBS to enable traceability and help integration of cost and technical baselines.

Schedule development and milestone identification involve identifying the specific activities that must be performed in order to produce the deliverables identified in the project's WBS. The work is described accurately and understood by those who perform the work. To help accomplish this, activity lists are generated that include supporting descriptions for complete understanding. The activity list includes all activities that will be performed on the project. It should be organized as an extension to the WBS to help ensure that it is complete and does not include activities that are not part of the project scope.

Sequencing of activities involves identifying and documenting interactivity dependencies. Activities are sequenced accurately in order to support the later development of a realistic and achievable schedule. Constraints on the start or completion of activities are identified. Certain assumptions are usually necessary for the establishment of a realistic, logically flowing activity sequence. These should be documented for discussion with the project participants.

Activity duration estimating is the establishment of realistic times to complete the identified activities. The individuals or groups most familiar with, or responsible for, a specific activity should estimate or approve these times in order to provide the most reasonable duration. Integration with cost and resource planning is generally required, e.g., determining what resources (people, equipment, and materials) and what quantities of each should be used to perform project activities.

Schedule development includes determining start and finish dates for project activities. If the start and finish dates are not realistic, then the project is unlikely to be completed as scheduled. The schedule development process must often be iterated (along with the processes that provide inputs, especially duration estimating and cost estimating) prior to determination of the project schedule.

Schedule development will also consider allowances for future situations that can only be planned in part, i.e., "known unknowns." Scheduled allowances are legitimate allowances, and, similar to cost estimate allowances, are analyzed and planned based on an assessment of scheduling risks. Allowances are incorporated into the project schedule baseline.

Pertinent schedules should be critical path method schedules, resource-loaded and leveled, and produced from precedence diagram method networks. Schedules should be reviewed and their status provided regularly—preferably at least monthly.

On large projects, an ongoing assessment and coordination of activity progress and analysis of dynamic critical path is essential to ensure participants adhere to their schedule baselines to achieve planned completion dates. The overall project schedule should have the capability to account for progress on a contract-by-contract basis for projects having multiple contracts.

Use of progressively lower-level networks is necessary for analysis of the schedule interfaces between major participating contractors through a schedule hierarchy. Schedule delays in one contract may impact other contractors and could significantly disrupt resource availability, affect budgeted costs and impair progress. Figure 1 illustrates a suggested schedule hierarchy for a large project with multiple participants and multiple scheduling databases. Attachment 1 provides examples of typical project schedules. The schedule hierarchy is used for tracking progress and for identifying potential technical issues, areas needing further activity planing, areas of schedule uncertainty, budget issues, activity progress trends, and critical path issues.

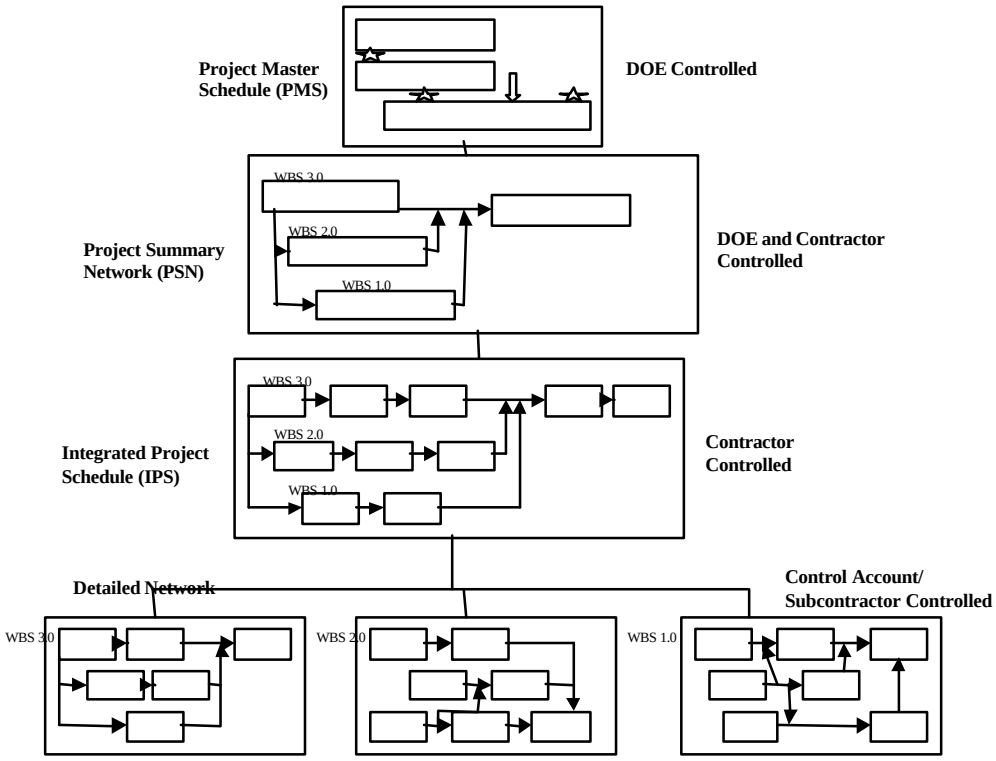

Figure 1. Project Schedule Hierarchy

The project master schedule is a summary activity bar chart with correlating milestones. All DOE controlled milestones are depicted. Identification of external milestones (e.g., Tri-Party Agreement milestones) should also be depicted. The master schedule is used by management as the primary tool to monitor and control the project schedule baseline. The master schedule illustrates the most significant schedule "drivers" (i.e., influences) affecting project completion.

The PMS is the controlling project schedule, and the PD signs each revision. For example, once the scheduled baseline has been established, logic link adjustments may be necessary to optimize the critical path or correct activity sequencing. Even though such adjustments are considered schedule maintenance and may not require change board approval, caution should be exercised when making logic-tie changes since a simple change may have a significant impact on budget-time phasing or projected completion of a baselined milestone.

The project summary network is an aggregated activity and logic network that illustrates the primary logic links between summary activities in higher WBS elements. It summarizes sequences of activities within a high-level WBS (usually WBS level 2) and recognizes significant logic links between WBS elements. The PD/PM uses the project summary network to monitor and control work scope that is on the critical path.

The integrated project schedule is the single schedule network database by which all project cost and schedule plans and performance is measured. It represents the detailed planning for the project and is used as the project's cost and schedule status mechanism throughout the life of the project. The integrated schedule and the master schedule are intermediate level schedules obtained from the same network database that provides greater detail than the master schedule. The integrator uses and maintains the integrated project schedule to control all project work. The contractor's functional managers (i.e., design engineering, construction management, and other groups) use the integrated project schedule to plan and monitor the completion of their scopes of work.

Detailed schedule networks are developed for individual scopes of work and WBS elements at a more detailed level, equivalent to or below the integrated project schedule. Detailed schedule networks should avoid too much detail, since that would become an unnecessary burden to maintain. These networks may be developed by cost account managers and/or by subcontractors for their scopes of work or functional area (i.e., design engineering). The primary purpose for detailed schedule networks is to allow the functional areas or subcontractors to plan and control their scheduled activities in parallel with the integrated project schedule. Each detailed schedule network is monitored and controlled by the managing (or integrating) contractor PM and should be integrated with the integrated project schedule to be considered a viable plan. The integration includes the activity logic, resources (when applicable), and progress status.

The integrated project schedule is contained in a database that can be coded, sorted or summarized to produce higher level schedules and specialized scheduling reports. Having the capability to selectively produce different types and levels of project scheduling reports and graphic plots adds to system flexibility. Master and intermediate (i.e., project summary network and integrated project schedules) level schedules can be produced from the critical path method scheduling database as required by management. The project should produce schedule diagrams and reports from the critical path network database that correspond to a specific level of the WBS.

On projects with minimum planning and scheduling requirements (e.g., small line items and general plant projects), the scheduling needs/requirements may be satisfied with start and complete milestones for project phases, and summary bar-chart schedules.

Projects with moderate planning and scheduling requirements should include DOE Headquarters and Field Office controlled milestones, formal milestone definitions, (e.g., dictionary), and a critical path method schedule.

Projects with high schedule risk should have additional system data, including more DOE-controlled milestones, formal milestone definitions (e.g., dictionary), critical path method schedule, and resource or dollar-loaded schedules.

2.1 Schedule Parameters

Schedule parameters include decision points, major milestones, initial operation, and other critical system events. The mandatory schedule parameters should include all phases of the project, major decision points, deliverables, and initial operation. A project may propose other major events, and they will be included in the PB following approval by the AE. If the threshold values are not otherwise specified, the threshold value for schedules should be the objective value plus six months for Major System projects and three months for non-Major System projects.

Schedule parameters are established through an interactive process that proceeds integrally with the technical and cost processes. Critical path activities, events, milestones, and resources are developed using a disciplined approach and properly integrated with all other appropriate elements. Schedules are to reflect realistic, risk-adjusted durations and milestone events that mitigate risks identified during risk analysis.

2.2 Schedule Preparation

This section describes a generic process for preparing project schedules. In certain cases specific direction is necessary to address special requirements such as those requirements applicable to project work. Such direction will be provided in each of the following subsections as necessary.

The process for preparing schedules is summarized as follows:

- Prepare planning schedule
- Develop schedule purpose
- Describe the scope of work
- Prepare WBS
- Establish milestones
- Identify schedule activities
- Apply network logic
- Define resources
- Assign resources to schedule activities/verify cost estimate for same activities
- Perform schedule calculations
- Assign risk-based allowances
- Prepare schedule reports
- Assemble the schedule package
- Obtain schedule approval

These steps are described in detail in the following sections.

The basis for all schedules should be critical path method schedules, resource loaded and leveled, and produced from PDM networks. Schedules include activities and milestones that indicate quantifiable end products of work. Schedules are reviewed and statused regularly; preferably on a monthly basis, as a minimum.

2.2.1 Planning Schedule Preparation

Preparation for planning and scheduling a scope of work should include the following steps:

- Establish when the schedule is required
- Determine who will prepare the schedule
- Select and notify individuals whose input will be required
- Collect scoping documents
- Obtain a cost estimate.

2.2.2 Develop Schedule Purpose

The purpose of the schedule should be stated in precise, unambiguous terms. The purpose statement should indicate why the schedule is being prepared and how it is to be used.

2.2.3 Describe the Scope of Work

The scope of work should be described so it clearly indicates which activities are included and which are not. The scope of work description should match the technical work scope.

2.2.4 Prepare the WBS

The WBS provides structure to the schedule, and should extend to at least the cost account level. The cost account level is the WBS level where work can be assigned to one responsible organizational element.

The WBS used in the schedule should be the same, or as close as possible to the WBS used in the cost estimate. The use of a common WBS greatly simplifies the assignment of resources to schedule activities and provides an easy method to reconcile the cost estimate and the schedule.

2.2.5 Establish Milestones

Milestones have no duration and resources are not assigned to them. Rather, they are frequently to flag the start or completion of an important activity or group of activities. Milestones are assigned predecessors and successors like any other activity in a network, and provide a measure of project completion.

Milestones are selected based on:

- Importance for monitoring project progress
- Ability to control the course of future work
- Availability of key personnel, facilities, equipment, or other important resources
- The need to flag important external and internal commitments
- Customer requirements.

Milestones are defined and identified as subcontractor, contractor, DOE-Program Secretarial Officers, or DOE-Headquarters milestones.

2.2.6 Identify Schedule Activities

Schedule activities are activity-based whenever possible. Activities should not be created that cannot be easily statused. There should be a strong relationship between schedule activities and activities in the cost estimate; they should be identical if possible. When necessary, several activities in the cost estimate may be combined to match an activity in the estimate. Generally, near term activities are more detailed than future activities. Activity durations are determined by those responsible for the activity. Duration times may be based on historic experience or extrapolated from similar activities. They may be developed from logical analysis of the activities and related to background experience of the planner or the performer. Performing organizations input should be sought whenever possible.

2.2.7 Apply Network Logic

Network logic is applied after the schedule activities and milestones have been identified and entered into the scheduling software. The activities and milestones are annotated in the software to indicate the planned flow of effort of the activities and the relationships between the activities. Annotation is usually accomplished by indicating the predecessor and successor for each activity and milestone. Additional annotation may include “must start on date,” “must finish by date,” or other similar constraints. The resulting activities and milestones and their annotated relationships are considered a Network. All activities and milestones in the schedule should be annotated with relationships of one kind or another.

Network logic is thoroughly developed to support calculation of an accurate critical path and meaningful resource leveling of the schedule.

2.2.8 Define Resources

A list of the resources required to complete the scope of work is compiled. Resources include labor, material, equipment, services, and any other cost items required to perform a scope of work. The list will normally be constructed and reside within the scheduling software. The list should also indicate the cost of using the resource. The availability of resources is determined and additional sources identified where appropriate.

2.2.9 Assign Resources to Schedule Activities

A resource-loaded schedule is created by assigning resources identified in the estimate to corresponding activities in the critical path method schedule. One or more resources can be assigned to an activity. A resource-loaded schedule is capable of providing resource and cost information, based on schedule dates. Resources are not generally assigned to milestones.

2.2.10 Perform Schedule Calculations

- *Critical Path Method Schedule Calculations*. Schedule calculations are performed after the network has been created. The scheduling software performs the schedule calculations. The software will calculate early dates by performing a forward pass of the network, and calculate late dates by performing a backward pass of the network. Activity float and the critical path will be identified using early and late dates. The specifics of performing schedule calculations are generally available in the users manual for the scheduling software. Schedule calculations can be performed at various times during the preparation of the schedule to allow preliminary reviews of the schedule. The schedule is reviewed and analyzed by the PM and the project planner, and optimized where appropriate. However, if task schedules are used to create the project schedule, those schedules should be prepared and approved by the task manager.

  The original durations for each activity in the network are derived from activity scope in conjunction with resource estimates. The DOE-Headquarters and Program Secretarial Officers milestones should be assigned date constraints consistent with their due dates. Additional reporting/analysis requirements, milestones, and other control points may be selected by the Program Planner based on overall risk and complexity. Newly defined control points should be added, logically tied, and assigned date constraints. The recalculated critical path schedule should be analyzed to confirm schedule logic. Early and late state/finish dates, float values, and schedule critical path(s) are established as a base for resource loading.

- *Resource Leveling*. A resource-leveled schedule uses limited resources more efficiently and eliminates the allocation of resources beyond their availability. A time constrained resource leveled schedule should be calculated. Each recalculation in the leveling process redistributes resources by rescheduling activities, using float where possible. If float is not available, an activity is scheduled without regard to resource limits. Where resource limits are exceeded, due to insufficient available float, additional resource availability needs to be resolved. Each schedule iteration should be analyzed for unnecessary constraints and/or inappropriate logic, which forces activities to be scheduled during periods of insufficient resource availability. Potential workarounds and/or removal of extraneous constraints/logic should be pursued, as required, to manage resource allocation. Prior to submittal for acceptance, the resource-leveled schedule is reviewed for viability in terms of completeness, critical path(s), and the applicability of the resource leveling options employed.

- *Assign Risk Based Allowances*. Part of the scheduling process is the work package manager determining the risk-based allowance which is derived from the uncertainty and unknowns associated with the task. The sum of all task-based allowances becomes the schedule allowance.

2.2.11 Prepare Schedule Reports

As a minimum, the schedule reports or graphics provide:

- A summary graphic of the schedule for the entire scope of work
- A detail graphic of the schedule for the entire scope of work
- Network logic
- Resources over time sorted by resource category
- Identification of the critical path and near critical paths.

2.2.12 Assemble the Schedule Package

A schedule package or report should be prepared for all schedules. Each schedule contains the same categories of information and requires the same types of documentation. Only the level of detail in the schedule varies. The schedule package or report supporting baselines, management decisions, or budgetary documents should include the following information. A graded approach should be used when documenting schedules for other purposes.

- *Schedule purpose statement*. A statement to clearly indicate why the schedule was prepared and how it will be used.
- *Technical scope summary*. A brief summary describing the scope of work represented by the schedule
- *WBS*. Should be included to allow easy understanding of how the work is organized.
- Summary and detail graphics of the schedule
- *Resource reports.* Graphical or tabular reports display total dollars and labor hours
- *Cost estimate.* A cost estimate, reflecting the same technical scope and cost as the schedule, should be included.
- *List of participants.* Schedule preparers and reviewers should be identified in the schedule documentation
- *Documentation*. Reviews and approvals documents.
- *Location of schedule files and reference information*. The schedule package should include documentation providing the location of the schedule, historical data, technical scope, and any other pertinent information used to prepare the schedule

- *Documentation of any changes to the schedule*. Schedules should be updated/modified periodically or as necessary. Updates should be documented promptly when significant changes occur.
- *Assumptions*. Identify all assumptions used in preparing the schedule

The format used to present this information is determined by the PM.

2.2.13 Obtain Schedule Approval

The Site Integrated Schedule, the Project Summary Schedules, and the Multiyear Work Plan (Performance Measurement Baseline) Schedules require contractor and DOE-PSO approval. All other schedules require contractor approval only unless DOE approval is specifically stipulated.

3.0 COST ESTIMATING

Cost estimates are prepared in a clear, consistent, comprehensive format that facilitates review of details and assumptions throughout the cost estimate review process. Activities to be estimated should be identified in sufficient detail to support the cost estimate methodology used.

The estimate details should clearly indicate the productivity factor used and the actual unit rates from the national or site database.

Cost estimates should have backup documentation in a centrally located file that explains the assumptions and calculations upon which the estimate is based.

The development of activities is driven by the project scope. Defining an activity includes the concept that it is a measurable unit of work. Necessary elements for activity definition are that it is measurable and is defined in terms of work output and not labor hours to perform. Each activity needs to have an identifiable unit of measure and, if appropriate, discrete quantities associated with that activity.

The appropriate level of detail depends on the potential for error or savings, and the maturity of the project being costed. As a project matures, scope, documentation, and the estimate can become more detailed based on more readily available cost, schedule, and other project data. Considerations for determining the estimate detail include:

- The level at which costs are to be collected (as a minimum).
- The level at which performance is to be evaluated.
- The repetitiveness of the activity.
- The dollar value of the activity and the potential for large or long-term savings.

- The level at which accurate cost data is available (historical costs, unit of work databases, costing methodology, etc.).

A WBS and WBS dictionary for each project should be included with the cost estimate. The dictionary should identify all activities for which costs were or are planned to be estimated. The WBS is a hierarchical system of defining where the elements of work scope, cost, and schedule meet and the structure against which they are compared.

To assist projects in identifying those costs that are typically assigned to Total Estimated Cost (TEC), Other Project Costs (OPC), and Operating-Expense (OPEX), a sample project classification guide for DOE projects is provided as Attachment 1. The sample provides examples of typical project situations by project phases, and describes where costs associated with each situation should be charged. A funding matrix is also included which identifies specific project activities by project phases, and the funding source for the organizations/personnel involved in each activity. Since each project is somewhat unique, the sample should be used as a resource and tailored to meet each project's specific needs.

For major system projects and non-major system projects, cost estimates address all the costs associated with the project—from preliminary design through the closeout phase. For Environmental Management, project estimates address all costs associated with the project life cycle, as appropriate. Environmental Management cost estimates may include startup, operating, and construction costs. Allowances included in cost estimates are based on risk assessments.

Cost estimates are prepared using appropriate estimating methodologies. Estimates for all contract work should be consistent with the WBS, and the DOE cost structure as specified by the DOE. The project ensures that all estimates are consistent with DOE Order 5700.2D, Cost Estimating Analysis, and Standardization, and with FAR clause 15.804, Cost and Price Data Analysis, as applicable.

Estimating the cost of a project in accordance with DOE standards is required by DOE Order 413.3. The DOE places importance upon the accuracy and validity of project cost estimates since they form the basis for funding requests and project cost and schedule baselines. DOE Order 413.3 and DOE Order 5700.2D require that cost estimates be developed and maintained throughout the life of each project, using the most appropriate estimating technique.

A thorough understanding of the project work scope is necessary to effectively estimate project costs. The project cost estimate, after approval of the conceptual design, is also the basis for a DOE funds request to Congress and budget authority to execute the project's work scope. The contractor's budget is time-phased according to funding and contractor resource availability. After the WBS is defined, the cost estimate is integrated with the activities and schedule logic for each WBS element. The level of detail in the estimate should be sufficient to provide confidence in the estimate's value to plan funding requests

and also to facilitate the calculation of control account resources and schedule activity durations.

A project's cost estimate integrates with the scope, schedule and cost baselines. The estimate is the basis of the project's cost baseline. Estimate integration with the WBS occurs when the scope of each WBS element has a specific and identifiable estimate of cost. In addition to the WBS requirement, the cost estimate is developed in accordance with other project related requirements specified by DOE, such as the DOE Cost Breakdown Structure, Project Data Sheet, Activity Data Sheet, etc.

The project prepares estimates, as applicable, in accordance with established project phases, maintaining a distinction between TEC, OPC, which are the non-TEC costs, and TPC. The project also maintains an appropriate cost estimating capability to accommodate project estimates-to-complete (ETC) and estimates-at-completion (EAC).

Throughout the phases of a project, reassessments of the cost estimate will be made as specified by the PD/PM. The capability should exist to calculate TPC, and cost estimates should have the ability to distinguish between TPC, TEC, and OPC, as defined in DOE Order 413.3. Most projects are required to provide a revised ETC on an annual basis. The ETC is an estimate of the cost and time required to complete a project's remaining effort including estimated cost of authorized work not yet completed and authorized work not yet estimated; it is generated in conjunction with the current project schedule. The ETC is a major component of the EAC which represents the total project cost at the completion of the project. The EAC includes cost-to-date, an ETC, and an estimate of claims liability. Requirements for the frequency of an EAC can be based upon the significance of project cost and schedule variances, project delays due to funding shortfalls or other project constraints, or significant project scope changes. The PD will consider the need and timing for an EAC and provides guidance to the contractor. However, on large projects, monthly EACs would be appropriate.

The cost account manager who forecasts any at-completion variances performs ETCs and EACs on a more frequent basis at the cost account level. The cost account manager should give particular attention to accounts that are developing unfavorable trends.

Escalation is an allowance to offset the impact of monetary inflation on the current estimated cost of an activity. Escalation is used to estimate the future cost of a project or to adjust historical costs to the present value. Escalation rates are developed by DOE HQ and provided to the field. These rates are to be used for all cost estimating unless otherwise specified in the Project Execution Plan.

Allowances are based on a valid and documented risk analysis and are included as part of the total estimated project cost to provide for costs that may be incurred due to incomplete design or other unforeseen or unpredictable conditions. The amount of allowance is based on assessing the degree of risk or uncertainty associated with all remaining project activities.

4.0 COST PARAMETERS

The cost parameters contained in the PB should identify the TPC and, in general, include direct costs such as research, development, test, construction, remediation, procurement, fabrication, services and items (equipment, design, etc.), transition and startup operations. Cost of quality, environmental, safety, and occupational health activities, as well as the costs of acquisition items procured with operations and maintenance funds are also included. Indirect costs not directly attributable to the project but resulting from the project, including any infrastructure costs, are to be included. For reporting purposes, the cost estimate uses life cycle costs and present cost figures in escalated (year of expenditure) dollars. These costs are identified as either TEC or OPC. Operationally funded projects may or may not segregate their costs appropriately in these categories, depending upon program guidance. Escalation rates should be documented and should be those published. Escalation rates used are documented as part of the PB approval process at Critical Decision-2. Multiple key cost parameters may be developed. At a minimum, key parameters are established for TPC and TEC. The TPC is a maximum parameter that cannot be exceeded without being classified as a Performance Baseline Deviation and presented to the SAE for a decision. All project estimates having a TPC greater than $5M should segregate their costs by TEC and OPC.

Cost estimates should initially reflect realistic and risk adjusted estimates of the TPC, including a careful and thorough assessment of risk. Budgeted amounts should not exceed the total cost objectives in the PB.

The cost parameters are limited to the TPC, TEC, and OPC in budget year dollars, and as with the other PB elements, are documented in the Project Data Sheet. The PB and TEC should only include costs that are part of the project as approved by the AE.

The threshold values for the TPC are a maximum parameter and are not to be exceeded.

5.0 ESTIMATE PREPARATION

This section describes a generic process for preparing cost estimates. In certain cases, specific guidance is necessary to address special requirements such as those applicable to project work. Such guidance is provided in each of the following subsections as necessary.

The process for preparing an estimate includes:

- Plan the estimate preparation
- Develop an estimate purpose statement
- Prepare a technical scope summary
- Develop an estimate specific WBS and dictionary
- Identify estimate activities

- Develop a schedule
- Define resources and crews
- Apply quantities to estimate activities
- Document qualifications and assumptions
- Assign resources to estimate activities
- Apply indirect rates, if applicable
- Assign risk based allowances
- Apply escalation factors
- Prepare estimate summary and detail reports
- Review and check the estimate
- Assemble technical scope detail
- Assemble the cost estimate package.

Each of these steps is described in the following sections.

5.1 Basis of the Estimate

The initial basis for any cost estimate should be documented at the time the estimate is prepared. The basis should describe or reference the purpose of the project element, significant features and components, proposed methods of accomplishment, proposed project schedule, research and development requirements, special construction or operating procedures, site conditions, and any other pertinent factors or assumptions that may affect costs.

If the estimate is prepared in support of another formal document that addresses these issues (i.e., a Conceptual Design Report or definitive design document), separate documentation is not required. If the estimate is a standalone document, or deviates substantially from a previous estimate scope, the above issues should be addressed and included in the estimate basis.

5.2 Plan the Estimate Preparation

Estimate planning should include:

- Establishing when the estimate is required
- Determining who will prepare the estimate
- Producing a plan/schedule for estimate completion
- Selecting and notifying individuals whose input is required

- Collecting scoping documents
- Selecting estimating technique
- Conducting an estimate kickoff meeting
- Visiting the work site

5.3 Develop Estimate Purpose Statement

The purpose of the estimate should be stated in precise, unambiguous terms. The purpose statement should indicate why the estimate is being prepared and how the estimate is to be used. This should include a description of any relevant regulatory or DOE drivers.

5.4 Prepare Technical Scope Summary

The technical scope summary should provide a detailed description of the work included in the estimate. Additionally, the technical scope should identify the activities included in the cost estimate as well as relevant activities excluded from the cost estimate and the rationale for their exclusion.

5.5 Assemble Technical Scope Detail

The technical scope detail should describe the project purpose and design parameters and provide supporting detail. Scope exclusions and the rationale for all exclusions are also provided. The technical scope detail lists all applicable codes, specifications, quality assurance requirements, drawings, data sheets, bills of material, engineering data, and any other items that define the scope of work.

5.6 Develop an Estimate-Specific WBS and Dictionary

Cost estimates are prepared and structured by WBS. The WBS is used throughout the life of each project for cost estimating, budgeting, scheduling, accounting, reporting, controlling and auditing. The WBS is structured in accordance with project specific requirements. Preparation of an estimate-specific WBS and activity dictionary for each project should be included in the cost estimate. The activity dictionary provides clear and concise definitions of all activities for which costs are estimated.

5.7 Identify Estimate Activities

The scope of work is divided into activities. Dividing work into activities will provide the following benefits:

- The specific nature of the work can be better defined and understood
- Portions of the work can be assigned to individual organizational elements
- Resources can be assigned using cost estimating relationships

- The work can be better planned and scheduled
- Changes to the cost estimate can be more easily incorporated

A tangible work output (deliverable) should be associated with each activity. If a tangible work output can be associated with an activity, then the activity is considered "activity based." If a tangible work output cannot be associated with an activity then the activity is considered "level-of-effort."

Activities appearing in an estimate should be the same activities that appear in the corresponding schedule, whenever possible. In some instances, several estimate activities might be combined to form a single activity in the schedule. An estimate activity may also be divided into several schedule activities. In any case, activities in the estimate should be easily traceable to the corresponding activities in the schedule. The WBS dictionary helps provide this traceability.

5.8 Activity-Based Estimates

To be activity based, an estimate activity must have discrete quantifiable units of work associated with it. Examples of work items that are activity-based include:

- Place 16 CY of concrete
- Produce 12 monthly reports
- Perform 100 surveillances
- Prepare a lesson plan for a course in safe lifting

5.9 Level-of-Effort

Certain activities cannot be associated with quantifiable units of work. Instead, these activities are expressed as a defined level of expenditure over time. Examples of level of effort activities include:

- Secretarial support
- Site safety program
- Clerical support

Estimates that include level-of-effort (LOE) activities should be closely scrutinized. The use of LOE estimates should be minimized.

5.10 Define Resources and Crews

5.10.1 Resources

Resources include the labor, material, equipment, services, and any other cost items required to perform a scope of work. One or more resource can be assigned to an activity. A list of

the resources and their associated unit prices needs to be defined before resources can be applied to activities in the estimate.

Unit prices for labor should include wages, taxes, insurance, fringe benefits, overtime, and shift differential when applicable.

Unit prices for material should include the material price, sales taxes, and shipping costs when applicable.

5.10.2 Crews

A crew is a grouping of the various labor classifications along with the tools and equipment (not installed equipment) required to accomplish a given activity. A production rate for each crew is identified. A crew used to place concrete slabs might include a foreman, laborers, cement finisher, concrete vibrators, and an air compressor. In addition, the crew's production rate might be established as 110 cubic yards per day.

The estimator should examine the production rate for each crew and make adjustments for local conditions if necessary. Working with crews, rather than the individual cost elements, allows the estimator to estimate work activities more quickly.

5.11 Apply Quantities to Estimate Activities

Each activity needs to have an identifiable unit of measure and a quantity associated with that activity. If level of effort is used, the quantity may be "one" and the unit of measure "lot."

5.12 Qualifications and Assumptions

The assumed conditions under which the estimator believes the project work scope will be performed is defined. The qualifications and assumptions may describe the types of work expected, the amount of work expected, the source of various materials, conditions in which the work is to be performed (winter, contaminated building, etc.) and any other information that significantly influences the estimate but is not clearly identified in the technical scope description. Major assumptions and exclusions that affect the project or the accuracy of the estimate are also described.

In completing this activity, the estimator identifies areas where work scope descriptions have deficiencies, or where key information is missing and has to be assumed. Vital information concerning the project is also identified for those reviewing or using the estimate.

Qualifications and assumptions should be described and documented at the most detailed level practical, and should be clearly described so an individual not intimately involved with the project can understand the estimate's basis.

5.13 Assign Resources to Estimate Activities

5.13.1 Unit Rates

- *Detailed Work Scope.* Once activities have been defined, units of measure identified, and quantities determined, resources are assigned to each activity. Unit rates are used to assign resources to estimate activities. The resources assigned should correspond with the resources that will be used in completing the work. For example, if direct labor is planned to construct an HVAC system, the HVAC system should not be estimated as a subcontract. This is especially important when detailed schedules are required and when resource planning is important. It is less important for ROM or Conceptual Estimates.
- Unit rates can be expressed as dollars per unit, as labor hours per unit, or as a percentage of an associated cost.
- *Direct labor*. Unit rates expressed as labor hours per unit require that the type of labor (carpenter, engineer, secretary, etc.) be identified by associating a labor type or a crew with each unit rate. A crew is defined by the various labor types that make up the crew. Each labor type has a corresponding wage rate to allow calculation of cost in dollars. The wage rates for each labor type includes the base rate, taxes & insurance, fringe benefits, travel or subsistence, and adjustment for overtime, if required.
- *Percentages*. Some activities may use percentages to assign resources. The appropriateness of using percentages for such items as project management and construction management will depend on the level of maturity in the work scope definition. Examples of cost items where percentages are often used include:
  - Small tools
  - Consumable materials
  - Labor insurance
  - Project management
  - Construction management

  Regardless of the method used to assign resources to an activity, the following is true for each activity:
  - All costs are identified
  - Labor hours, when applicable, are identified
  - Labor type for all labor hours is identified
- *Summary Work Scope.* When details of the work scope are not known, the work scope may be estimated by using the analogy technique or the parametric technique. These techniques may use unit rates expressed as dollars per unit, labor hours per unit, or percentages.

- *Costs Included in Unit Rate.* All costs should be "fully burdened." A description of what is included in the burdened rate should be included because the definition of "fully burdened" frequently varies.

5.13.2 Adjusting Unit Rates

The development and/or use of estimating factors to adjust unit rates requires the skills of an experienced cost estimating specialist. This can be an important tool for the cost estimator as it allows use of a database with known productivity or costs, and then adjusts that base information depending on the project specific activities and the conditions under which the work is to be performed. Major categories that might affect productivity include type of work, weather conditions, working conditions, arid schedule.

Examples of estimating factors (fictional):

- Add 25 per cent to labor for work in radiation zones
- Reduce labor for shop work by 20 per cent
- Add 20 per cent to labor for work requiring use of a respirator.

Estimating factors are available from published sources or can be developed by the estimator. For example, the U. S. Army Corps of Engineers, "Productivity Study for Hazardous, Toxic and Radioactive Waste (HTRW) Remedial Action Projects," dated October 1994, provides suggested labor productivity adjustment factors considering levels of worker protection and temperature.

5.14 Apply Indirect Rates

The development of indirect rates is usually the responsibility of both the financial accounting organization and the cost estimator. The financial accounting organization determines rates for organizational overheads and General and Administrative Cost, while the cost estimator usually estimates rates for project management, construction management, and subcontract costs. The estimator, however, should clearly understand how all indirect rates are to be allocated in the estimate to avoid duplication. The estimator should know and document what is included in the indirect rates.

Indirect rates for work to be done by DOE contractors should be developed by the contractor and approved by the DOE. Backup information that clearly describes how the indirect rates were developed is provided and maintained by the contractor. Indirect rates should be evaluated and revised on a periodic basis as necessary.

Indirect rates estimated for subcontract work such as Architect/Engineer services, construction, and remedial actions should be estimated and documented at a level of detail appropriate to the type of cost estimate being prepared.

There is not a uniform standard for establishing indirect rates; a typical method for applying indirect rates calculates indirect costs as a percentage of a category of work. For example:

- Quality control inspection is estimated as 6 per cent of direct craft labor
- Consumable material is estimated at 6 per cent of direct craft labor
- Administrative support for engineering is estimated at 38 per cent of direct engineering

The basis for applying individual indirect rates will vary greatly depending on the specific costs included in the rate. Allowances for small tools or consumable materials would typically use the direct labor cost of the appropriate construction craft, operations or maintenance activities as its base. General and administrative costs are usually estimated using the sum of all direct and indirect costs for the specific items of work as its base.

Indirect rates should be documented in detail so that what is included (and excluded) in each rate is clear. A separate line item in the estimate should exist for each rate used.

5.15 Develop a Schedule

The estimator should prepare or be provided a schedule for the work scope being estimated. Preparation of an estimate and a schedule should occur at the same time, and the estimate and the schedule should coincide as closely as possible to the following:

- Reflect the same WBS
- Reflect the same or very similar activities
- Reflect the same resources.
- Reflect the same TPC.

The estimate should contain a statement that refers to the schedule as an attachment. Each version of a cost estimate and a schedule should be signed and dated.

5.16 Apply Escalation Factors

Escalation is the provision in a cost estimate for increases in the cost of equipment, material, labor, or other costs over time and is calculated using escalation rates or indices. Most cost estimating is done in “current dollars” and then escalated to the time when the work is expected to be performed. Escalation has two main purposes:

- *Convert historical costs to current costs.* This is usually accomplished by using indices from recognized sources. The estimator should be certain that the indices used are applicable to the type of cost being updated.
- *Project current costs into the future*. This is done using DOE prescribed escalation rates or indices.

5.16.1 Using Escalation Rates

Escalation rates for predicting future costs are computed and applied by two methods, depending on the type of cost being estimated. Project costs are calculated by escalating the current year costs to the midpoint of completion of each element of the project (see DOE Cost Estimating Guide). Dividing the work into fiscal year increments and applying escalation on a yearly basis usually escalates operations activities.

5.16.2 Sources of Indices and Escalation Rates

- *Project Estimates*. The DOE-Headquarters provides annual esca1ation rates for developing project baselines for construction, waste management, and environmental restoration projects; these rates are to be used. Rates should be evaluated by the contractor for possible differences due to regional conditions.
- *Operating Expense Estimates*. The DOE provides escalation rates each year in the Unified Field Budget Call Letter for operating expense activities. These are Office of Management and Budget (OMB) prescribed rates and are to be used unless alternate rates are approved.
- *Other Sources*. The following sources provide escalation indices that can be used to facilitate escalating historical cost data to current price levels. The estimate preparer selects the indices most appropriate for the intended use.
  - — "Means Construction Cost indexes" construction cost indices on a quarterly basis
  - — The "Engineering News Record" historical construction cost indices on a quarterly basis.
  - — The "Means Construction Cost Data, The Annual Edition" historical construction costs indices for 162 major U.S. and Canadian cities, and includes formulas for calculation
  - — The "Bureau of Labor Statistics, Monthly Labor Review, Employment Cost Index Section" historical labor cost indices.

5.17 Assign Allowance

The application of risk-based allowances should be considered in all estimates. The application of allowance is both prudent and necessary. Allowances are derived from a risk analysis of various aspects of the scope being estimated. This analysis concerns cost, schedule, and technical risks as they apply to the project effort, underscoring the uncertainties that exist in each of the elements. The magnitude of the allowance will depend on the status of planning, design, procurement, and construction, and the complexities and uncertainties of the operation or component parts of the project element.

Allowances are applied as a percentage of a particular cost or category of work. Allowances should be applied at a summary level based on a review of each major cost category/activity.

The base estimate should be a best effort to develop the expected cost, and then an allowance analysis performed and the allowance developed. Some allowance generalities include:

- Allowance can be applied at an activity level or at a summary level. Preferably, allowances are applied as close to the activity level as possible.
- Allowance should consider the varying degree of risk associated with a scope of work.
- Allowance should not be used to avoid the effort required to prepare a properly detailed and documented cost estimate.

Higher or lower allowances may be appropriate, based on an analysis of project complexity, technical characteristics, and associated risks.

Although allowances are to be consumed as the work is performed, the distribution of allowances to cost accounts is controlled through a formal change control process.

5.18 Prepare Estimate Summary and Detail Reports

There are many acceptable cost estimate report formats. The cost estimate package should include, as a minimum, the following information that may be combined or, if practical, presented separately. DOE may require some or all this information depending on the specific need or use.

- The cost estimate, sorted and summarized by WBS, showing all line items
- The cost estimate, sorted and summarized by WBS, showing no line items
- The cost estimate, sorted and summarized by WBS, showing all line items, indicating type of cost (labor manhours, labor dollars, material dollars, equipment dollars, subcontract dollars, other dollars)
- The cost estimate, sorted and summarized by WBS, showing no line items, indicating type of cost (labor manhours, labor dollars, material dollars, equipment dollars, subcontract dollars, other dollars)
- The cost estimate, sorted and summarized by cost element (as defined by accounting), showing no line items.
- The cost estimate, sorted and summarized by resource type, showing no line items. Labor manhours and labor dollars are shown. The cost estimate, sorted and summarized by WBS, indicating where escalation was applied and how much escalation was applied. The cost estimate, sorted and summarized by WBS, indicating where allowance was applied and how much was applied. The cost estimate, sorted and summarized by WBS, indicating where indirect costs were included and how much indirect costs were included

- The cost estimate, sorted and summarized by WBS, showing all line items, that indicates units (quantity), unit measure (CY, SF, etc.), and the unit rates used for each line item.

5.19 Review and Check the Estimate (Peer Review)

Competent and qualified personnel who have not been involved in preparing the estimate should review cost estimates. This review provides an unbiased check of the assumptions, productivity, and cost data used to develop the estimate. A peer review is a vital step in providing consistent, professionally prepared cost estimates. The review should be documented to indicate:

- The name of the reviewer(s)
- The date of the review
- Review comments and comment disposition

5.20 Assemble the Cost Estimate Package

A cost estimate package or report should be prepared for all cost estimates. Each estimate package should contain the same categories of information and the same types of documentation; only the level of detail in the estimate package varies. The contractor determines the format used to present this information. A cost estimate package or report supporting baselines, management decisions, and budgetary documents should include the following information. A graded approach to cost estimate packaging and reporting should be used when documenting cost estimates for other purposes.

- *Estimate Purpose Statement*. The reason the estimate was prepared.
- *Technical Scope Summary*. Brief description of the technical scope.
- *Technical Scope Detail.* A statement providing the details of the technical scope necessary for a thorough understanding of the work. This may be by reference to specific technical documents.
- *Estimate Specific Work Breakdown Structure (WBS).* A breakdown of the organization and composition of the estimate.
- *Estimate Summary and Detail Reports.* A presentation of the estimate details in a variety of ways (i.e. “Sorted” for labor type/by WBS etc.).
- *Resource and Crew Listing*. A breakdown of the type of resources used in the estimate.
- Qualifications and Assumptions. Factors affecting the estimate that are not readily apparent by reviewing the reports.
- *Estimate Methodology and Unit Rate Sources*. A description of how resources were applied to the estimate activities that are not apparent by reviewing the reports. Identify the methodology used to prepare the estimate, the sources of unit rates, and vendor quotes.

- *Method and Justification for use of Indirect Rates*. Information not obvious by reviewing the reports.
- Method and Justification for use of Allowances: information not obvious by reviewing the reports.
- Method and Justification for use of Escalation: an explanation of escalation rates used and how they were obtained and applied.
- Schedule: a time frame for the work to assist in understanding how escalation was applied. The schedule should reflect the same technical scope and cost as the estimate.
- List of Participants: a list of contacts for questions about the estimate. Estimate preparers and reviewers should be identified in the cost estimate documentation.
- Documentation of Review and Approval: evidence that the estimate was reviewed and approved.
- Location of Estimate files and reference information: a location to obtain copies of the estimate, review the original, and review information that was not included in the estimate package. The cost estimate package should include documentation providing the location of the estimate, historical data, technical scope, worksheets and any other pertinent information used to prepare the estimate.
- Documentation of any changes to the estimate: clarification of how and where the estimate was changed, eliminating the need to review the entire estimate. Cost estimates should be updated/modified as necessary. Updates should be promptly documented when significant changes occur.

5.21 Cost Estimate Changes

The need to formally control changes to a cost estimate are dependent on the use of the estimate. Generally, those estimates supporting project baselines are changed through a formal process. The need to make changes to a cost estimate is generally based upon the determination that the estimate is no longer an accurate portrayal of the expected cost for a given scope of work.

Changes require documentation, and as each estimate is updated, modified, or revised, an audit trail is maintained to show the relationship between the new estimate and the previous estimate. The reason(s) for each change should be identified, such as change in scope, change in labor rates, change in escalation, project reprioritization, etc., in a manner that will permit verification of the specific quantitative change(s) in the cost estimate. Changes may be documented by the use of addenda, officially approved change request documents, or by completion of a new estimate. The method used depends upon the magnitude of the estimated change and the underlying causes. All estimate changes should include the appropriate level of indirect costs, escalation and allowances, as dictated by the phase of the project when the change was identified.

The process of revising and updating cost estimates supporting project baselines may frequently involve the use of change requests.

Change requests are standard format documents which describe proposed changes to approved technical, cost and/or schedule baselines. Change requests are the official means by which all changes to the cost baseline should be documented by the DOE-PAS.

Change requests are prepared using contractor procedures and forms.

6.0 COST AND SCHEDULE CONTROL

6.1 Schedule Control

Project schedule management and control is directly tied to project scope and cost management and control. To develop an overall project schedule, a project's subtier work packages including those at the lowest level, are identified, sequenced logically, and scheduled individually. Cost constraints or need dates may require iterative scheduling. Schedules may be developed in series, parallel, or a combination of series and parallel work packages. Preparation of a detailed level schedule results in higher confidence in the scheduled completion date. Summary schedules should identify requests for critical decisions, and, as appropriate, testing, closeout and turnover activities.

A project schedule is prepared for planning, monitoring progress, and visualizing ways to resolve problems. Inclusion of frequent, measureable milestones in a project schedule is required for monitoring progress and identifying potential schedule problems, particularly those related to the preparation, submission, and processing of environmental permits and applications. Project schedules are also necessary for identifying resource requirements, including funding and manpower.

6.2 Cost Control

Cost reporting formats are defined, approved and established in the project's life cycle.

Project funds control should, as a minimum, be established at a contract level. Project funds are generally made available as obligational authority is received. Contractors are required to notify DOE when accumulated costs and commitments attain a predetermined limit, usually 90 percent of total obligational authority. Under no circumstances are costs to be incurred or commitments made in excess of total obligational authority. Obligational authority usually released in fiscal year increments.

Effective cost control depends upon a well-defined technical, schedule, and cost baseline. Cost estimates made at succeeding project stages should be reconciled with any previous estimate through linkage of the cost estimate to modifications in the technical baselines. Project cost estimates should be prepared so data can be presented in the following formats, depending on the needs of the project.

- *Product breakdown*. Provides logical, definitive "work packages" that can be identified, planned, and executed as single units. Work packages may be a total system, subsystems, or components, each of which would typically include work by several disciplines or performing organizations.
- *Functional breakdown*. Establishes estimated project costs by discipline and/or performing organization or participating contractor.
- *Project element breakdown*. Establishes estimated project costs by major categories of effort, which are typically summarized under the following headings:
  - — Engineering, design, and inspection,
  - — Construction
  - — Government-furnished equipment/materials,
  - — Project administration, and
  - — Allowances.

6.2.1

Periodic comparison of accumulated costs against the baseline cost estimate provides the fundamental basis for cost control. Cost content and definition should be the same, and in the same format, for both cost estimates and cost accounting systems. For planning and reporting, a logical connection should be made between scheduled work packages and estimated work package costs. Each work package should be estimated, scheduled, and have costs accumulated and reported against it.

6.2.2

Effective risk allowance management is best assured by establishment of a single, risk allowance fund with controlled access. A system for periodic performance measurement against cost commitment and allocation curves is used for complex or long duration projects and may be useful for smaller projects. Where allowance management is a significant aspect of the project, an allowance usage or management plan should be included as part of the PEP.

6.2.3

During the life of a project there may be revisions to its project schedule baseline. The preliminary baseline schedule is developed as part of conceptual design; the baseline range schedule is developed during preliminary design. Schedules should be developed or revised on at least the same frequency as are cost estimates since accurate schedules are the basis of accurate cost estimates. A revised .baseline may result from the added visibility of preliminary or final design. Further revision may result from analyses made by the construction manager or subcontractor. The only other condition that should cause a change

in the schedule baseline is an engineering change. Each schedule baseline change is approved by the appropriate project change board.

6.2.4

There are a variety of scheduling methods. For simple or short duration projects, scheduling methods such as bar charts, Gantt charts, etc., are acceptable. For complex or long duration projects, the activity oriented, critical path method with real time axis is preferable. Activities should be identified by unique start and finish points which allow application of computer drawn diagrams, using programs that are readily available.

6.2.5

A detailed project schedule incorporates all project work that is to be accomplished. The ability to discern individual project activities improves as a project progresses through design. This design detail refinement allows improved schedule detail which, in turn, enhances cost estimate accuracy. Once scheduled activities have been identified, the relationship among those activities is defined. Constraints, parallel and sequential activities, and interfaces with other projects, organizations are identified and made part of the schedule.

6.2.6

Project status reports, using summary schedule charts, should be updated and presented at least monthly as part of project reporting. Schedule formats should be appropriate for project complexity, size, and contractual arrangements.

6.2.7

Schedule updating means revision of a working schedule network once management determines the current baseline is no longer accurate or realistic. Justification and authorization for working schedule revisions is documented by the project. Certain changes may require DOE approval; this must be determined on a case-by-case basis by the cognizant PD/PM. Schedule revision may become necessary when the current baseline is no longer realistic, regardless of cause.

7.0 COST ESTIMATING TECHNIQUE

The techniques used for preparing cost estimates will necessarily vary with: the project's phase of acquisition and degree of definition; the state-of-the-art of the project; the availability of data bases, cost estimating techniques, time, and cost estimators; and the level of detail or work breakdown structure required in the estimates. A study of the item or task, in light of the degree of estimating difficulty, should indicate the method or combination of methods to be used in estimating the cost of that particular item or task, as follows:

- *Bottoms-Up Technique.* Generally, a work statement and set of drawings or specifications are used to takeoff material quantities required to perform each discrete task performed in accomplishing a given operation or producing an equipment component. From these quantities. direct labor, equipment, and overhead costs are derived and added thereto.
- *Specific Analogy Technique.* Specific analogies depend upon the known cost of an item used in prior systems as the basis for the cost of a similar item in a new system. Adjustments are made to known costs to account for differences in relative complexities of performance, design, and operational characteristics.
- *Parametric Technique.* Parametric estimating requires historical data bases on similar systems or subsystems. Statistical analysis is performed on the data to find correlations between cost drivers and other system parameters. such as design or performance parameters. The analysis produces cost equations or cost estimating relationships that can be used individually or grouped into more complex models.
- *Cost Review and Update Technique.* An estimate is constructed by examining previous estimates of the same project for internal logic, completeness of scope, assumptions, and estimating methodology.
- *Trend Analysis Technique.* A contractor efficiency index is derived by comparing originally projected contract costs against actual costs on work performed to date. The index is used to adjust the cost estimate of work not yet completed.
- *Expert Opinion Technique.* May be used when other techniques or data are not available. Several specialists can be consulted reiteratively until a consensus cost estimate is established.

Cost estimates can be developed for many purposes: comparative studies, trade-off studies, funding decisions, project changes, cost-benefit analyses, procurement support, and for independent review or analysis of another estimate for a test of reasonableness. Cost estimates will include all relevant costs depending on the purpose of the estimate (e.g., total life cycle costs or components thereof, such as research, development, production, commercialization, and operating, support, and decommissioning costs, as appropriate). Cost estimates identify assumptions made in developing the estimate that are important in understanding or evaluating the estimate.

8.0 LIFE CYCLE COST ESTIMATES

Life Cycle Costs (LCCs) equal acquisition costs (total project cost [TPC]) plus ownership costs (ownership includes operating, maintenance, and support of an asset throughout its life and through disposition), less revenue estimates are included in the cost and funding information presented for most proposed DOE projects. These estimates are used to justify the following types of activities:

- Trade-offs and other decisions for DOE projects for Energy System Acquisition Advisory Board reviews and decisions
- Equivalent environmental actions and planning
- Congressional budget requests.

The PD/PM is responsible for including LCC estimates in the project decision-making process and ensuring that downstream ownership costs are not neglected. Program Offices also are responsible for ensuring that LCC estimates are properly balanced in decisions.

In general, LCC estimates have greater leverage in tradeoffs and alternative comparison and selection when they are included early in the project. For example, design decisions affect operations, maintenance, and disposal, which are the major drivers of ownership costs. The earlier trade-offs are identified and evaluated, the fewer resources necessary to explore inferior alternatives, and the more flexibility remains as to the alternatives considered, particularly in view of sunk costs that might be avoided.

LCC considerations are often ignored because they tend to increase up-front costs. For example, more expensive equipment may be necessary to reduce maintenance costs, and just estimating LCCs increases design costs. Nevertheless, LCC estimates should not be neglected because potential leverage could be lost. LCC estimates should be prepared for the following purposes:

- Critical Decision-1, Alternative Selection and Cost Range
- Preparation for negotiating compliance agreements
- Support of Environmental Impact Statements and site treatment plans
- Support of feasibility studies and remediation measures
- Budget submissions for fixed assets
- Comparison of alternatives.

9.0 TAILORED APPROACH

As a minimum, all projects should have schedule and cost estimates that are developed from a documented DOE approved work scope as the basis for the project cost and schedule baselines. Levels of detail, techniques, review or approval, and review frequency will vary with the size of the project and the degree of project risk determined. The project risk assessment will influence cost estimating precision and detail needed by evaluating factors such as the type of work (from research to construction) and schedule phase (preconceptual design to construction or clean up).

Allowances are risked-based and assessed for the entire project. It is generally developed at lower component levels as deemed necessary by the PD/PM.

10.0 ATTACHMENTS

Attachment 1, Example Project Schedules:

- Figure 1, Integrated Project Master Schedule
- Figure 2, Project Summary Schedule
- Figure 3, Working Level Schedule.

Attachment 2. Project Classification Guide and Matrix.

ATTACHMENT 1. EXAMPLE PROJECT SCHEDULES

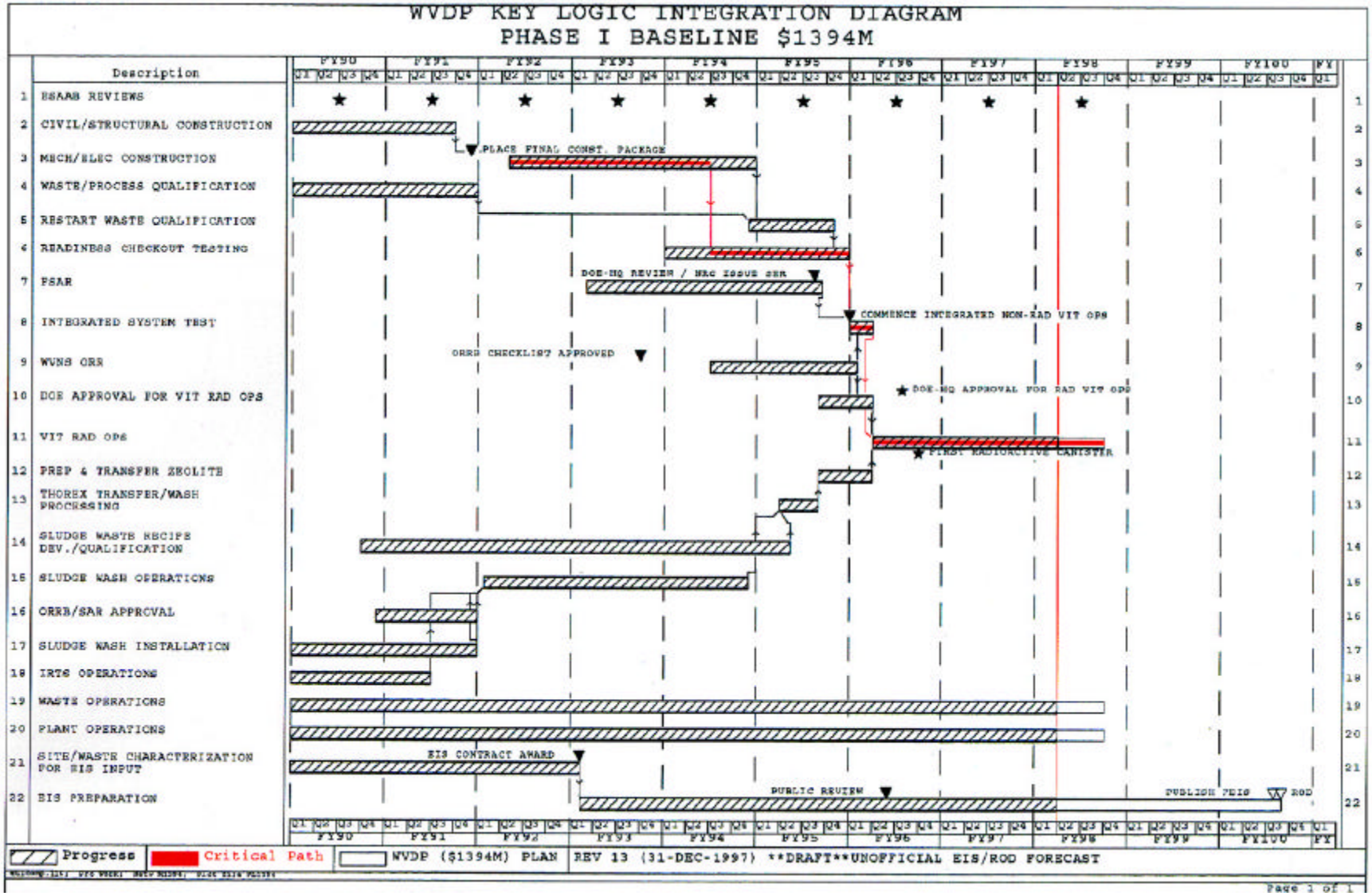

Figure A-1. Integrated Contract Master Schedule

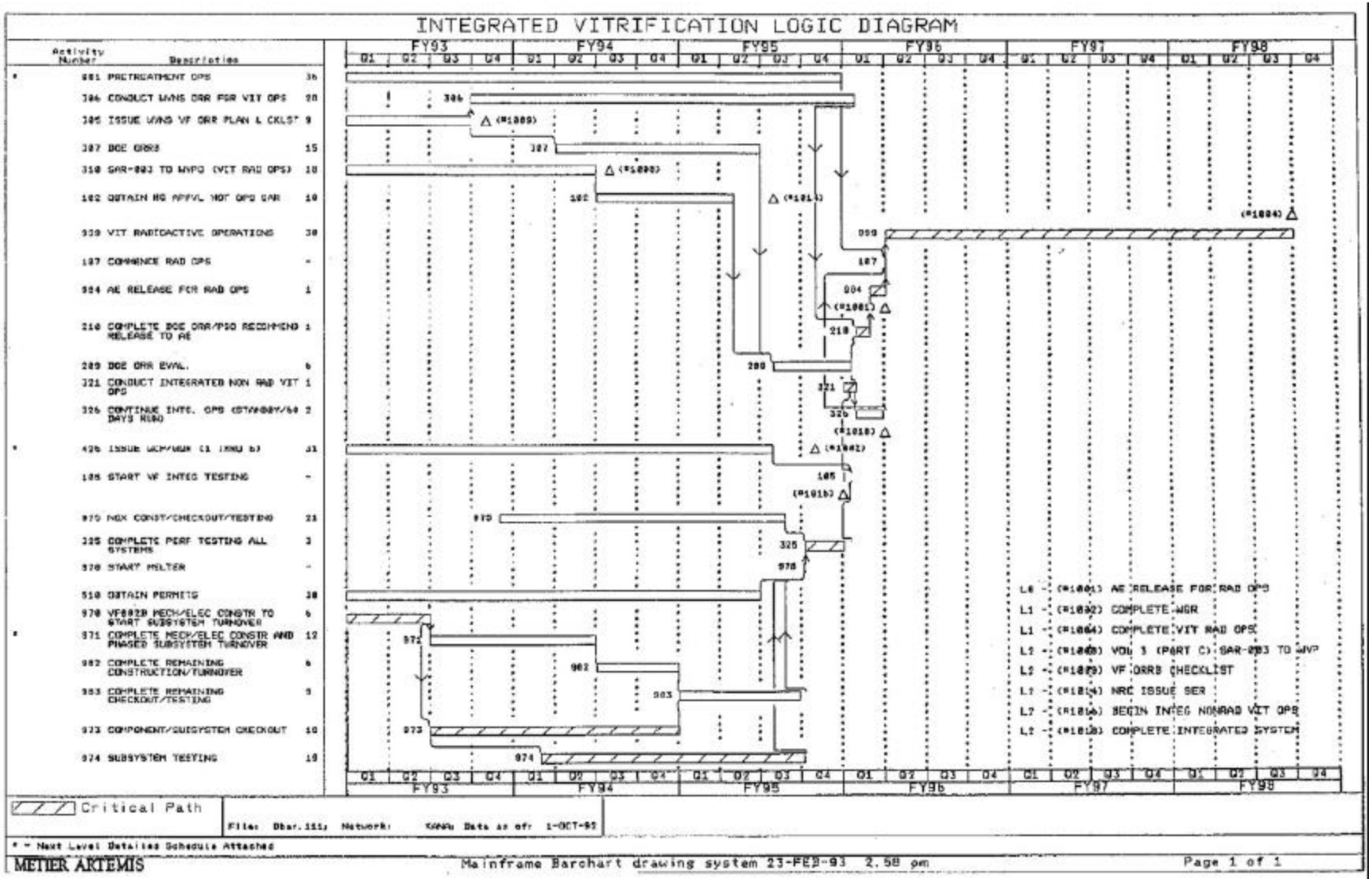

Figure A-2. Project Summary Schedule

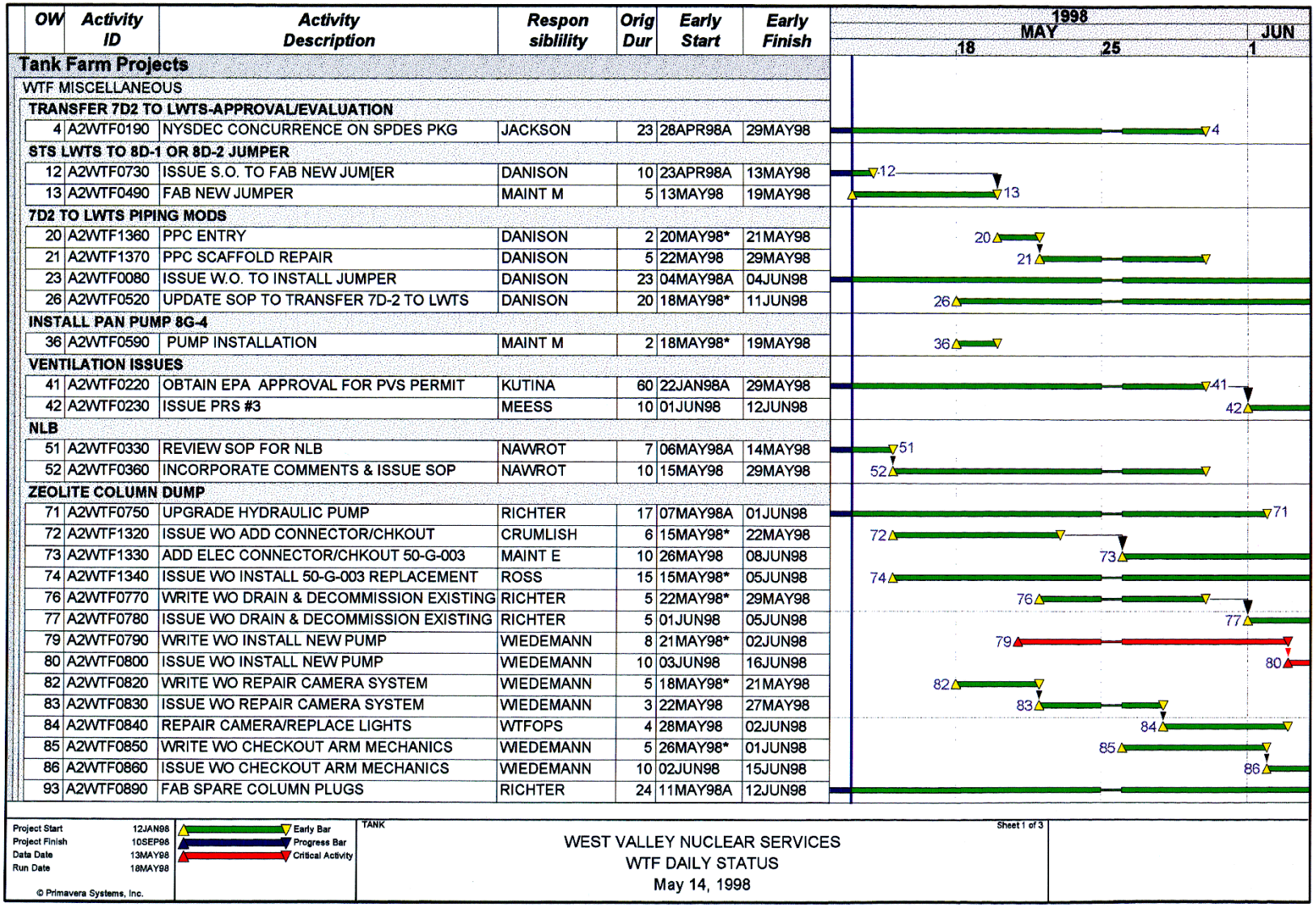

Figure A-3. Working Level Schedule

ATTACHMENT 2. PROJECT CLASSIFICATION GUIDE

General Guidance

The following is intended as guidance and is not to be used as reference for developing official financial policy. If official financial policy is required, regarding where Line Item costs are charged, contact a Controller's representative. This guide is also based on a contractor's project organization, not the DOE's project organization. Expenditures associated with projects are total project costs (TPC). TPC equals the operating expenditures, referred to as other project costs (OPC), and capital expenditures are referred to as the total estimated cost (TEC). DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets," establishes the Project Management Baseline as the TPC, and increases in TPC require Program Assistant Secretaries (PAS) approval. Proper estimating, management, and meaningful earned value are vitally important for both TEC and OPC. The general relationships between TEC and OPC are shown in Figure A-1.

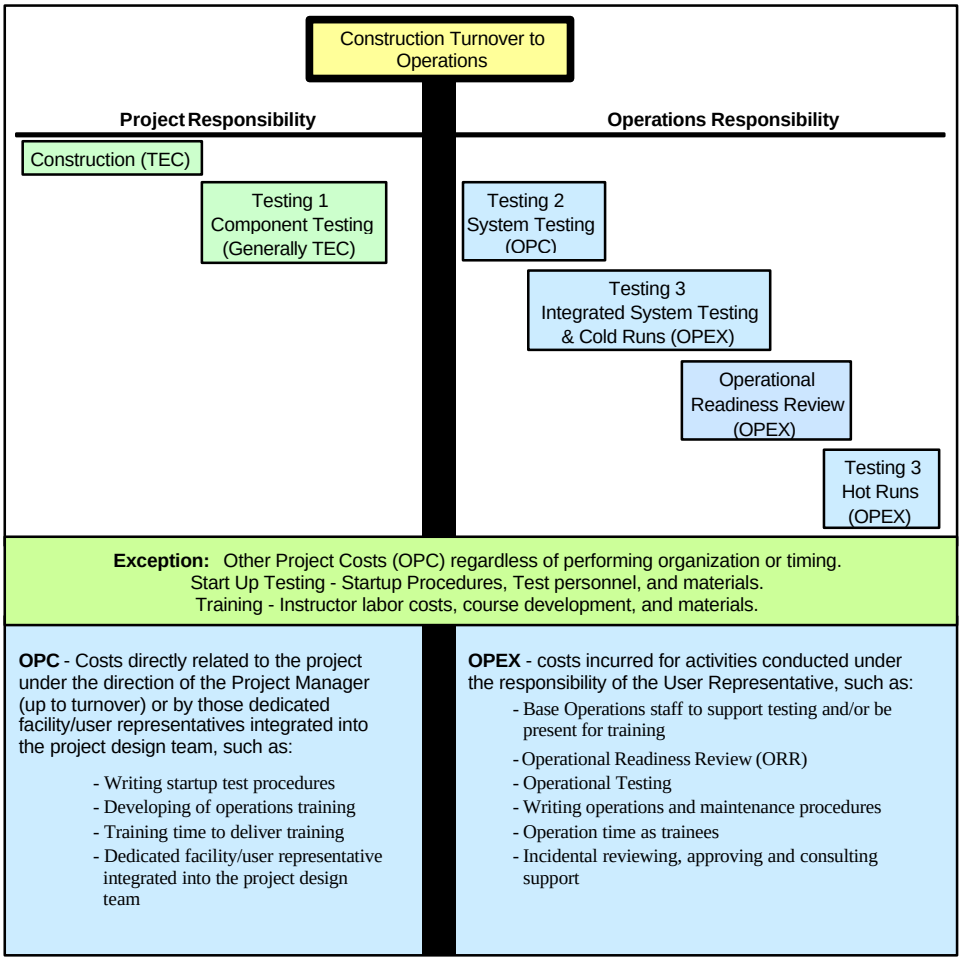

Figure A-1. Relationships Between TEC and OPC

A detailed discussion of the various project phases and the charging practices for OPC and TEC follows, including examples and a matrix showing where costs are typically classified.

PRE-ACQUISITION PHASE

Prior to Critical Decision (Critical Decision-0), Approve Mission Need, the program identifies the need for the project, the acquisition strategy and plans, and the required funding strategy. All direct and indirect costs incurred in the pre-acquisition phase regardless of the activity or performing organization are normally classified as operating expenditures (OPEX). When an IPT is assigned to develop deliverables for CD-0 and costs are collected and tracked, pre-acquisition costs may be budgeted as OPC.

Other Project Cost (OPC)

DOE approval of mission need (Critical Decision-0) is the start of the conceptual stage of the project. OPC cost classification commences with Critical Decision-0. OPC is defined by the Budget Formulation Handbook, Chapter III, "OMB Budget Review." The categories of OPC include:

- R&D Necessary to Complete Construction
- Conceptual Design Costs
- Decontamination and Decommissioning (D&D)
- NEPA Documentation
- Other ES&H permitting documentation costs
- Other Project Related Costs incurred on a one time basis such as startup and training.

A Project Team consisting of the user, program, and various support organizations is organized to insure that the project complies with program, facility, and site needs, and site and industry standards. The project user is responsible to host the project by providing technical and administrative oversight (advisors, reviewers, consultants, SME, etc.) to insure that the project meets requirements, specifications, and criteria. Generally, operations personnel who represent the user are "non-dedicated" and perform these activities "incidental" to their normal job responsibilities. In other words, support personnel absorb these activities as part of their normal duties and charge the appropriate operating (OPEX) cost account and not the OPC of the project. User and support personnel who are conducting "hands on" OPC activities and not acting in the capacity of site overseers (approval authority), advisors, consultants, subject matter experts (SME), or reviewers do charge the OPC of the project.

All other operations personnel (non-project) assisting (incidental) charge the appropriate OPEX account. These personnel include: management, reviewing and advising engineers and

technicians, works control, schedulers, procurement, clerks, and so forth. Support personnel that are "not hands on" charge the sponsoring program OPEX account.

Following is a brief discussion of the OPC categories and examples of how these costs should be classified.

1) Research & Development (R&D) Necessary to Complete Construction

Due to the complexity of financial rules surrounding R&D, request the Controller's direct participation in planning and executing these activities.

Generally, projects requiring an R&D program as a prerequisite to specific design and construction are specified and disclosed in the OPEX appropriation request as OPC. Typically, R&D activities include all work up to the time when the ideas or conceptual design for the project or individual components are crystallized and are ready for the preliminary design work leading to a specific construction or fabrication project. Research and development activities include the development of conceptual designs, origination of ideas, and laboratory investigations to obtain scientific and engineering data, as well as activities directed toward the investigation and development of technical improvements in such projects, processes, systems, or components during the construction or fabrication period.

The "hands on" rule is applicable.

- Project management personnel overseeing the R&D charge the OPC of the project
- Subcontractors hired by project management to complete R&D activities directly linked to conceptual design charge the OPC of the project
- Operations and support organization personnel who are conducting "hands on" R&D activities charge the OPC of the project
- All other personnel (non-project) assisting (incidental) charge the appropriate OPEX account and not the OPC.

Typically, capital funds (TEC) are not yet available during "directly related" R&D of a project.

Example #1

A laboratory technician is assigned as a member of a team conducting actual R&D that is on the critical path necessary to complete conceptual design of a project. The R&D has been specifically disclosed and appropriated in OPEX as OPC. The technician is the actual preparing agent, and not acting in the capacity of a technical advisor.

The lab technician is "hands on" and charges the OPC of the project. All other assisting indirect support personnel such as Laboratory management, work schedulers, work planners, procurement, and clerical personnel or others are incidental and charge OPEX.

Example #2

A program engineer, the project sponsor, has been assigned to participate on the project team, but continues to perform routine duties as well as work with the project team. In this capacity, the engineer attends project and technical R&D meetings, offers advice, gives counsel, provides integration with the facility, and reviews R&D documentation and other related project documents.

This individual is not considered "hands on" and charges the appropriate OPEX account. All other assisting personnel charge the appropriate OPEX account. Project Management personnel would charge the OPC of the project.

2) Conceptual Design

Costs incurred in the development of the Conceptual Design Report (CDR) are classified as OPC.

The "hands on" rule is applicable.

- Project management personnel overseeing the conceptual design charge the OPC of the project.
- Subcontractors hired by project management to complete conceptual design activities directly linked to conceptual design charge the OPC of the project.
- Operations and support organization personnel who are conducting "hands on" conceptual design activities charge the OPC of the project.

All other personnel (non-project) assisting (incidental) charge the appropriate OPEX account and not the OPC.

Example #1

A fire protection engineer, assigned to a technical support group, attends a project meeting, consults regarding the current site and industry standards, and reviews and approves the conceptual design to insure project compliance with industry and site standards for sprinkler systems.

The fire protection engineer is acting in the capacity of consultant and does not charge OPC, but the appropriate OPEX account.

Example #2

A site utility engineer reviews a conceptual design and attends a walk-down to review the physical location for installation of power boxes and outlets, consults with the PM and facility representatives regarding site and industry standards.

The site utility engineer is acting in the capacity of consultant and does not charge OPC, but the appropriate OPEX account.

Example #3

A facility, program, or support organization design authority engineer participates as a member of the project team, attends meetings, consults with the PM, reviews and approves project

conceptual design documents to insure that they are in compliance with the operating program acceptance criteria. The design authority continues other program activities, and in addition, also provides similar support for various other General Plant Project and Capital Equipment projects.

The design authority represents the user, is not preparing specific conceptual design, but acting in the capacity of oversight, reviewer, and advisor. Time spent by the engineer attending meetings, consulting with project management, and reviewing project conceptual design documents is charged to the appropriate OPEX account and not the OPC.

Example #4

A facility, program, or support engineer's organization design authority engineer is integrated into the project design team. The full job scope is to support the PD/PM in the development of the conceptual, preliminary, and final design and as such has no other responsibilities.

The engineer is dedicated to the project and charges the OPC of the project through construction completion and turnover to the user. All other base operations personnel (non-project) assisting (incidental) charge the appropriate OPEX account. These personnel would include, but are not limited to; management, reviewing, and advising engineers and technicians, works control, schedulers, procurement, clerks, and so forth.

3) Decontamination and Decommissioning (D&D)

Expenditures for D&D are easily confused with the dismantlement and removal (D&R) costs directly in the project footprint which are charged to TEC. Due to the complexity of financial rules surrounding D&D as OPC expenditures, request the Controller's direct participation in planning and execution activities.

D&D is removing hazardous material (typically radioactive or chemical material) from facilities, soils, or equipment by washing, chemical action, mechanical cleaning, or other remediation techniques. D&D activities in regard to a project primarily pertain to safety and health issues related to facilities and/or equipment necessary for access to and egress from the construction area.

Generally, funds for D&D activities directly related to a project are specified and disclosed as OPC in the OPEX appropriation request. Typically, projects do not require D&D as a prerequisite to construction.

The "hands on" rule is applicable.

Project management personnel overseeing D&D charge the OPC of the project.

- Subcontractors hired by project management to complete D&D activities directly linked to D&D charge the OPC of the project.
- Operations and support organization personnel who are conducting "hands on" OPC D&D activities charge the OPC of the project.

— All other site personnel (non-project) assisting (incidental) charge to the appropriate OPEX account and not the OPC.

Typically, capital funds are not made available during directly related D&D of a project.

Example 1

The project footprint is located in a contaminated room of a building. In order to use the facility, the equipment, several walls, doors, and shielding will have to be removed. In order to allow for the construction to take place in the room all contamination will also have to be removed.

The costs of decontamination are charged to TEC, since it is part of the effort required for construction. Project management personnel overseeing the effort charge the TEC of the project. Subcontractors hired by project management to complete activities directly linked to the effort charge the TEC. Operations and support organization personnel who are conducting "hands on" TEC activities charge the TEC. All other site personnel (non-project) assisting (incidental) charge the appropriate OPEX account.

Example 2

Same as above, except in order to have access to the construction area, a room outside the project footprint must be decontaminated. The room is not scheduled for any other preplanned project work and must be decontaminated for safety and health of the construction forces requiring access to the construction area.

D&D of the room would be classified as OPC. Generally, the need for this effort would have been disclosed in the program OPEX appropriation request as OPC. The cost of decontamination is charged to OPC, since it was not part of the work in the footprint of project. Project management personnel overseeing the effort charge the OPC of the project. Subcontractors hired by project management to complete activities directly linked to the work charge OPC. Operations and support organization personnel who are conducting "hands on" OPC activities charge the TEC. All other site personnel (non-project) assisting (incidental) charge the appropriate OPEX account.

4) National Environmental Protection Agency (NEPA) Documentation Costs and Other Environmental Safety and Health Permitting and Compliance Actions.

Costs directly related to the project, incurred for NEPA or other ES&H permitting and compliance, including Environmental Assessments (EA), Environmental Impact Statements (EIS), permitting actions, and site characterization are classified as OPC.

The "hands on" rule is applicable.

— Project management personnel overseeing environmental compliance activities charge the OPC of the project

— Subcontractors hired by project management to complete environmental compliance activities directly linked to conceptual design charge the OPC of the project

— Operations and support organization personnel performing “hands on” OPC environmental compliance activities charge the OPC of the project

— All other site personnel (non-project) assisting (incidental) charge the appropriate OPEX account and not OPC.

Example #1

A technician in the environmental protection group is assigned to prepare the NEPA documentation necessary to permit construction and operation. Sponsoring program personnel support the preparation by attending NEPA support meetings, offer advice, consultation, provide facility information, and review the documentation and other related documents.

Project management personnel overseeing these permitting and compliance activities charge the OPC of the project. The environmental specialist preparing the document is considered “hands on” and charges the OPC of the project. All other personnel acting as advisors, consultants, reviewers, and subject matter experts charge their appropriate OPEX accounts.

Example #2

The project hires a subcontractor to prepare the NEPA documentation necessary to permit construction and operation.

Project management personnel overseeing these permitting and compliance activities charge the OPC of the project. The subcontractor costs are charged to the OPC of the project. All other personnel acting as advisors, consultants, reviewers, and subject matter experts charge their appropriate OPEX accounts.

5) Other Project Related Costs

Other project related costs include miscellaneous project support, incurred on a one time basis, such as startup testing and training.

Start-up testing is performed to verify the project meets the requirements, and therefore are classified as OPC. Start-up is defined as those costs associated with start up testing, such as:

— Developing test procedures

— Labor for test conductors

— Materials

— Start-up training, such as,

- Cost of instructors
- Course development

- Training materials
- Trainee costs are included in base operations, not OPC.

Costs directly related to the project incurred for activities under the responsibility of the PD/PM, or those by user representatives integrated into the project design team, are charged to OPC or TEC depending on the activity. This would include costs up to the point the project turns over responsibility and accountability to the user. Turnover could on a system-by-system basis or as a complete facility.

The "hands on" rule is applicable.

— Project management personnel overseeing start-up activities will charge the OPC of the project.

— Subcontractors hired to complete start-up will charge the OPC of the project.

— Operations and support organization personnel who are conducting "hands on" start-up activities will charge the OPC of the project.

— All other site personnel (non-project) assisting (incidental) charge the appropriate OPEX account and not the OPC.

Once turnover to the user has been achieved the project will standby to correct project deficiencies charging TEC until Critical Decision-4, Approve Project Transition Complete, at which time the project is financially closed.

All costs for activities conducted under the responsibility of the user, such as operations and maintenance procedures, are charged to the appropriate OPEX account, regardless of the performing organization or timing. This would include incidental costs incurred for reviewing, approving, and consulting.

Example #1

A project is constructing a new facility to replace an existing one. At the end of construction, a start-up group is assigned to perform component testing under the responsibility of the PM as well as system testing under the responsibility of the user. A number of operators have been assigned to support the start-up group during testing.

The start-up group's time spent performing component tests (prior to turnover) is charged to TEC. The start-up group's time conducting system tests (after turnover) is charged to OPC. All other site personnel assisting (incidental) charge the appropriate OPEX account.

Example #2

A project is constructing a new facility that requires 40 operators receive training on the new systems. Accordingly, training is contacted and assigns personnel to develop the courses and conduct training prior to completion of construction

The labor cost of the "hands on" course developers, instructors and training material is charged to the OPC of the project. The labor cost of the trainees is charged to the

appropriate OPEX account. All other site personnel assisting (incidental) charge the appropriate OPEX account.

Example #3

A senior operator, part of the existing base operation, is assigned, in addition to their normal duties, to prepare the start-up test procedures and the operating procedures for a new facility.

The Operator's time spent preparing start-up and operating procedures is charged to OPC. All other site personnel assisting (incidental) charge the appropriate OPEX account. Maintenance procedures are treated the same as operations procedures.

Example #4

An operating technician, part of the existing base operation, is assigned, in addition to their normal duties, to act as an observer during a start-up engineer's test efforts. This participation has the dual purpose of learning the new systems, reviewing with an experienced eye, and consulting with the user regarding the procedures and test results.

The operating technician charges the appropriate OPC account. The start-up engineer charges the OPC.

Example #5

A subcontractor has been hired by the operations manager to write operational start-up test procedures and operating procedures. The contractor is not the design contractor, but has been hired specifically to support start-up and continued operations. The contract will end upon completion of the procedures.

The subcontractor costs for preparation of the start-up test and operating procedures is charged to OPC. .

Total Estimated Cost (TEC)

Total Estimated Cost (TEC) charging commences with Critical Decision-1, Approve System Requirements and Alternatives. Projects are responsible for completing the Congressionally authorized work scope, and TEC includes all costs incurred to complete the project in compliance with established requirements. The TEC is defined as the capital cost of the project, including the cost of land and land rights, engineering, design (following conceptual design), inspection, direct and indirect construction costs, and the cost of initial equipment necessary to place the plant or installation in operation. Accordingly, TEC includes, but is not limited to:

- Engineering and design
- Dismantlement and removal
- Materials and transportation
- Construction

- Indirect costs (For purposes of allocating indirect costs to a project, this means, in addition to fringe and organizational burden, an equitable share of all general and administrative and other sitewide common support activities).

The “hands on rule” is applicable when considering labor costs chargeable to TEC. Following is a brief discussion of TEC with examples.

1) Engineering and Design

Preliminary and final design costs incurred for the definitive (not conceptual) design of the project. Design begins with Critical Decision-1, Approve System Requirements and Alternatives, and continues through Critical Decision-3, Authorization to Complete Implementation. Preliminary and final design can be accomplished by using subcontractors or site forces depending upon required expertise or other circumstances. All directly related design costs will be charged to TEC.

The “hands on” rule is applicable.

- Project management overseeing design charges TEC.
- Subcontractors performing preliminary and final design activities charge TEC.
- Site base operations personnel performing preliminary and final design activities, who are considered “hands on” preparing agents and not acting in the capacity of site overseers (approval authority), advisors, consultants, subject matter experts or reviewers charge TEC.
- Design Authority Engineers dedicated and integrated into the project design team supporting preliminary and final design charge OPC of the project.

All others charge the appropriate OPEX account.

Example #1

Due to the security aspects of the project a site engineering organization has been assigned to do the preliminary and final design for a project. No design subcontract has been awarded. Engineers from support organizations are assigned to the project team and perform design review and approval. In support of this effort, they get electrical engineering, process engineering, Quality Assurance, fire protection, and others to review the work for compliance assurance with industry and site standards.

The engineers doing the design are “hands on” and charge the project TEC. The engineers performing reviews charge the appropriate OPEX account.

2) Dismantlement and Removal - Razing the construction area

Dismantlement and Removal costs are charged to TEC. In general, unless specifically disclosed and authorized by the appropriation request, the project is responsible for all dismantlement and removal inside the footprint of the project. Only those costs incurred in the designated construction area (footprint), required to complete construction are included.

Dismantlement and Removal includes the decontamination, removal of debris and equipment, destruction of structural components, packaging of rubble, and transportation to the disposal site.

Subcontractors performing dismantlement and removal activities charge TEC. Site base operations personnel who are performing project specific activities, who are considered "hands on" preparing agents and not acting in the capacity of site overseers (approval authority), advisors, consultants, subject matter experts (SME), or reviewers charge TEC. All others charge the appropriate OPEX account.

Example #1

An old reactor assembly bay is being converted to a storage facility for nuclear material. In order to accomplish this task the project would be required to pay for the following:

Removal of:

- Stripes from the floors
- Insulation from the walls
- Contaminated shielding
- Alarms
- Ventilation equipment
- Old offices
- Overhead cranes and doors,
- Packaging and transportation of rubble to the landfill
- Packaging and transportation of excess equipment to excess yard
- Packaging and transportation of reuse equipment to the site decontamination center
- Decontamination and transportation of reuse equipment and material to reuse the facility.

All costs (except the last) are charged to TEC. The project is only responsible for packaging and transportation to the disposal site, not for the decontamination of old equipment or material. The only exception would be if the project intended to reuse the decontaminated equipment or material in the new construction.

Example #2

Part of the project scope is to provide a new heat source for the facility. The project only needs to blank off the old heat source and install the new one. The program desires that the project dismantle and remove the old abandoned facilities.

The project is not responsible for facilities outside the footprint of the project unless removal is necessary for the new facility to be fully functional. Exception: If the dismantlement and removal of abandoned facilities is included in the project TPC baseline,

and adequately disclosed on the Project Data Sheet, then these facilities will be dismantled by the project as D&D activities and charged to OPC.

Example #3

A maintenance mechanic and electrical/instrumentation mechanic perform a lock and tag-out in order for construction subcontractors to begin work in the construction area. Their work is scheduled by the scheduling group in the ordinary course of business.

In this scenario, both mechanics are considered to be performing work incidental to their job and charge the appropriate OPEX account. All other site personnel supporting this action charge their appropriate OPEX account. Project management would continue to charge TEC.

3) Materials and Transportation

The cost of direct material used in construction is charged to TEC. The costs would ordinarily include, in the contract price, the cost of packaging and transportation to the site.

Project management procurement personnel supporting these efforts would charge directly to the project, unless they are included in organizational overheads and distributed on a rated basis.

Site procurement support costs incurred in ordering, storing, or transporting materials is ordinarily incidental and charged to the appropriate OPEX account. In other words, for cost to be charged to the TEC of a project, it must be in addition to the cost of normal operations.

Example #1

Material control centers reside in various locations across a site and serve numerous organizations and personnel. The centers as a matter of routine serve operations and incidentally provide support to projects. The cost of the operation would be born by site operations if no projects existed in the area.

The costs for the material control centers would be charged to the appropriate OPEX account. However, projects could receive a distributive share of the cost if it is determined that projects have a casual beneficial relationship.

Example #2

The project has purchased materials and rain delays have created the need to store them until required for construction. No onsite storage is available and offsite storage is the only available alternative. The PM rents the required warehouse space, and stores the material at the storage site. Later, the project transports the material and unloads it at the construction site.

The storage, transportation, and unloading costs incurred under these circumstances are charged to TEC.

Example #3

The project requires the installation of a generator for emergency power. The PM determines that site diesel mechanics will install the supporting system for the generator. The diesel mechanics use the material control center support to procure parts rather than project procurement personnel. The part is transported from receiving to the area as part of a routine shipment.

The cost of the part is charged to TEC. The labor cost of the mechanic doing the installation is charged to TEC. The material control center personnel ordering the parts is incidental to their normal job responsibilities and charge the appropriate OPEX account. Use of site transportation to deliver the part is incidental to routine transportation and is charged to the appropriate OPEX account.

4) Construction

Construction is the erection, installation, or assembly of a new plant facility; the addition, expansion, improvement, or replacement of an existing facility; or the relocation of a facility. The "hands on" rule is applicable. Construction includes, but is not limited to:

- Related site preparation
- Equipment installed in and made part of the facility
- Excavation
- Filling and landscaping or other land improvements
- Electrical work
- Heating
- Plumbing
- Built-in air conditioning
- Ventilating systems, sprinklers;
- Elevators utility lines
- Roads
- Distribution piping systems
- Initial complement of equipment, furniture and minor items.

Construction begins with Critical Decision-3, Authorization to Complete Implementation, and continues until the user assumes responsibility for the products/deliverables. Construction is performed by subcontract or site forces or by both, depending upon the circumstances.

Subcontractors performing construction activities charge TEC. Site base operations personnel who are performing "hands on" construction activities and not acting in the

capacity of site overseers (approval authority), advisors, consultants, subject matter experts, or reviewers charge TEC. All others charge the appropriate OPEX account.

Example #1

An operating organization handles radioactive materials in the ordinary course of operations. The organization maintains a staff of radiation control technicians in support of these operations. The facility requires a project to install new generators within one of its facilities. The project proceeds and is supported by radiation control technicians assigned to the area.

The radiation control technicians are considered incidental to construction and charge the appropriate OPEX account and not TEC.

Example # 2

During construction, the PM determines that more radiation control technician support is required to support round-the-clock construction efforts. As a result, the PM hires a radiation control subcontractor for the remaining duration of construction.

The subcontractor charges TEC. Any radiation control technicians support provided by the operating organization will continue to charge OPEX.

Example #3

A water line is damaged by construction in the project footprint. The site has different types of water in the area and requires site water services support to determine the type of water and shut it off for repair. The water services group sends a group of technicians to shut the water off and review the damages, and consult on the work necessary to repair the line. The program sends out quality assurance and safety personnel to advise and consult with the construction subcontractor. The water services department agrees that its site forces will repair the water line. A group of water services employees and a their supervisor goes to the site and completes the repair.

The labor and material charges incurred by the group executing the repair is charged to TEC. The labor of the water services technicians sent to consult on the shutoff and repair is charged to OPEX. Program and support organization work schedulers, planners, management, technical advisors, procurement specialists, and others charge the appropriate OPEX account.

Example #4

The same facts as above, except the water services department technicians provide recommendations and the PM hires a contractor to execute the repair.

The subcontract cost of the repair is charged to TEC. The labor of the water services technicians sent to consult on the shutoff and repair is charged to OPEX. The cost of the shutoff is charged to OPEX. Program and support organization work schedulers, planners, management, technical advisors, and others charge OPEX.

Example #5

Project management is required with every project to turn over a material equipment list to operations for maintenance purposes. Operations uses a site-wide computerized maintenance management system. The PM agrees to provide the initial input in the maintenance management system since it would require about the same time as preparing the master equipment list. Operation personnel review the initial input and request the project to provide more than minimal required detail, requiring significantly more time.

The Project is only required to provide operations with the minimum necessary for them set up and accomplish operational maintenance, in this case the master equipment list. Since the PM agreed to make the initial input into the maintenance system the project personnel charge TEC. Operation personnel doing the initial review charge the appropriate OPEX account. If project management provides additional information into the maintenance management system for the convenience of operating program, then project personnel doing the additional work charge the appropriate OPEX account.

Example #6

Assume same facts as in 5 above, except that the project must provide maintenance services to installed equipment pending project completion and decides to use the maintenance management system and inputs the initial required and additional data for its own purposes. The project personnel charge TEC. Operation personnel review cost charge the appropriate OPEX account.

5) Post Turnover Project Deficiency Corrections

At the end of construction, the project turns the completed products over to the user. During operational testing and readiness reviews, any project deficiencies identified are to be returned to the project. The PM corrects the deficiencies and charges the TEC.

Example #1

A new line item construction project installed a waste tank that is supposed to accept high-level waste sludge and mix it with low-level waste sludge to reduce the strength to acceptable levels for vitrification. After the project has been tested and accepted, operations realizes that the motor control centers and the related valve system is introducing more radioactive sludge into the tank than specified by the project design criteria. A review of the system indicates that the motor control centers have to be reconfigured in order to correct this situation. The design agency is called in and the design modified and the system changed to correct this deficiency.

The project costs for the design modification and construction are charged to TEC. The PM continues to charge TEC.

6) Indirect Cost

The project TEC will receive an allocation of cost for site-wide common support activities, i.e., General and Administrative & Essential Site Services.

PROJECT FUNDING MATRIX

A sample funding matrix has been prepared to serve as guidance for PD/PMs in determining where specific project activities are typically charged/funded. Not all the identified activities will apply to each project, and tailoring should be applied when using this matrix.

Matrix Instructions

The following Matrix is intended to be a supplement to the Project Classification Guide and is not to be used as reference for developing official financial policy. If official financial policy is required as to where costs are charged, contact a Controller's representative.

The matrix was formulated primarily from steps used by project management to execute projects and designates the accounts that are typically charged. The various phases of a project are designated with the activities conducted under that phase.

The matrix heading Support Organization is any other organization that supports a user, including but not limited to:

- Environmental Safety, Health, Quality Assurance
- Facility support services
- Technical services
- Laboratory services
- The matrix heading Project includes but not limited to:
- Project Management
- Project Controls
- Construction

Colors are used to delineate activities conducted under the responsibility of:

- Project Manager (green)
- Program Manager (yellow)

Matrix Keys:

- Step – Key Activity
- Action – The key activity being performed.

The "X" indicates the classification of the cost, OPEX, OPC, or TEC. The ** asterisks show where personnel conducting "hands on" TPC activities will be classified. "Hands On IPT Member" means personnel from base operations who are actually the performing or preparing agent(s) of specified TPC activity and not acting in the capacity of advisor, reviewer, consultant, or subject matter expert. For instance, conducting experiments, doing conceptual or definitive

design and drawings, dismantling equipment, construction, conducting pre-turnover component testing, etc. In addition, “hands on” precludes base operations program and support organization management, works control, schedulers, procurement, legal, accounting, planning, human resources, and other similar support organizations.

The project user representatives, participating on the IPT are representing the user and are considered advisors and charged to the appropriate OPEX account. The exception is the user Design Authority (DA), dedicated and integrated into the Project Design Team, who charges the OPC of the project. Otherwise, the DA will charge OPEX.

Project Classification Guide Matrix

		User			Support Org.			Project		
Item	**Activity**	**OPEX**	**OPC**	**TEC**	**OPEX**	**OPC**	**TEC**	**OPEX**	**OPC**	**TEC**
CONCEPTUAL PHASE										
Start of Conceptual Design - Critical Decision-0										
1	Review CD-0 Information	X			X				X	
2	Review As-Is or As-Found Drawings	X			X				X	
3	Develop As-Is Design Drawings	X			X				X	
4	Prelim Geotechnical Investigation*(GPR is considered OPEX when verifying Ops-owned as-builts)*	X			X				X	
5	Identify Permit Requirements *(plan and strategy)*	X	**		X	**			X	
6	Determine if RSA/ORR Applies	X			X				X	
7	Develop Acquisition Strategy	X			X				X	
8	Establish Scopes of Work (SOW)	X			X				X	
9	Confirm Long-Lead or Special Procurements	X			X				X	
10	Develop Preliminary Procurement Plan	X			X				X	
11	Develop Systems-Level Functions & Reqm'ts	X			X				X	
12	Develop Project Execution Strategy	X			X				X	
13	Confirm Need for Phased Project Implementation	X			X				X	
14	Identify & Control Technical Interfaces	X			X				X	
15	Initiate Performance Reporting	X			X				X	
16	Prepare Preliminary Hazard Analysis Report	X	**		X	**			X	
17	Develop and intiate Project Controls & Estimating Plan	X			X				X	
18	Develop and initiate Configuration Management Plan	X			X				X	
19	Develop Funding Plan	X			X				X	
20	Review Design Altern. & Select Design Approach	X	**		X				X	
21	Identify Project Codes, Standards & Procedures	X			X				X	
22	Complete Technical Reqs & Prepare Procurement Pkg for Subcontracting Conceptual Design	X			X				X	
23	Perform Safety/Operability/ Maintainability Review	X			X				X	
24	Verification of Perf Criteria via Test & Eval (if app)	X			X	**			X	
25	Update Preliminary/Final Design Estimate Range	X			X				X	
26	Initiate NEPA Documentation Preparation	X	**		X	**			X	
27	Develop Prelim Design Phase Budget & Schedule	X			X				X	
28	Update Cost & Schedule Range	X			X				X	

		User			Support Org.			Project		
Item	Activity	OPEX	OPC	TEC	OPEX	OPC	TEC	OPEX	OPC	TEC
29	Prep & Issue Request for Project Authorization	X			X				X	
EXECUTION PHASE										
Start Preliminary Design - Critical Decision-1										
30	Perform Preliminary Design	X			X					X
31	Define Special Procurements	X			X					X
32	Develop, Validate & Issue Partial CD-3 Special Procurement Pkg	X			X					X
33	Commit Critical Equipment	X			X					X
34	Complete Ident. Environ. Permit Req'm (NEPA)	X	**		X	**				X
35	Prepare Division of Responsibilities Matrix	X			X					X
36	Develop Staffing Plans	X			X					X
37	Finalize Project Site Selection	X			X					X
38	Define CD-3 Deliverables & Completion Criteria	X			X					X
39	Prepare Project Data Sheet for Construction	X			X					X
40	Update Annual/Out-year Budget Authority	X			X					X
41	Develop Proj Cost, Sched & Technical Baselines	X			X					X
42	Develop Project Baseline Estimate	X			X					X
43	Award Final Design Subcontract	X			X					X
44	Conduct Estimate Review	X			X					X
45	Update PEP & Incorporate PMB	X			X					X
46	Prep Integ Project Schedules with Milestones	X			X					X
47	Complete Technical Requirements & Prepare Procurement Pkg for Subcontracting Final Design	X			X					X
48	Prepare Detailed Schedules	X			X					X
49	Prepare Performance Metrics	X			X					X
50	Issue Preliminary Safety Analysis Report	X			X					X
51	Final Geotechnical Investigation (GPR is consid-ered OPEX when verifying Ops-owned as-builts)	X			X					X
52	Facility Environmental Review	X			X					X
53	Facility Preliminary Safety Analysis Report	X	**		X	**				X
54	Develop Project Specifications	X			X					X
55	Develop Preliminary Operations Plan	X			X					X
56	Update Acquisition Strategy	X			X					X
57	Review/Update Project Metrics	X			X					X

		User			Support Org.			Project		
Item	Activity	OPEX	OPC	TEC	OPEX	OPC	TEC	OPEX	OPC	TEC
58	Develop Temporary Construction Facility Plan	X			X					X
59	Prepare Detailed Resource-Loaded Schedules	X			X					X
60	Perform Process Hazards Review & Revise Preliminary Hazards Analysis	X			X					X
61	Perform Design Process Hazards Review	X			X					X
62	Complete Technology Development Activities	X	**		X	**				X
63	Issue for Design Plot Plan, Piping Drawings (P & ID's), Equipment Lists & Piping Specs	X			X					X
64	Finalize NEPA Documentation	X	**		X	**				X
65	Prepare Risk Management Assessment	X			X					X
66	Submit Critical Decision-2	X			X					X
67	Conduct Performance Baseline Reviews	X			X					X
Start Final Design - Critical Decision-2										
68	Perform Final Design	X		**	X		**			X
69	Review/Update Integrated Project Schedule	X			X					X
70	Issue Final PEP	X			X					X
71	Prepare Equipment & Material Requisitions	X			X					X
72	Perform Pre-Turnover Maint. (Stored & In Place)	X			X					X
73	Value Management (Final Design Phase)	X			X					X
74	Finalize Detail Engineering Field Support Plan	X			X					X
75	Update Schedules	X			X					X
76	Prep Detailed Construction Work Sched	X			X					X
77	Perform Safety/Operability/ Maintainability Review	X			X					X
78	Final Acceptance of Subcontract Final Design	X			X					X
79	Complete Final Design	X			X					X
80	Develop Design Complete Estimate	X			X					X
81	Perform Risk Management Assessment	X			X					X
82	Verify Mission Need	X			X					X
83	Submit CD-3	X			X					X
84	Support CD-3	X			X					X
Start Construction - Critical Decision-3										
85	Issue Construction Subcontract Solicitation Pkg	X			X					X
86	Award Construction Subcontract	X			X					X
87	Bulk Materials Purchase Placement	X			X					X

		User			Support Org.			Project		
Item	Activity	OPEX	OPC	TEC	OPEX	OPC	TEC	OPEX	OPC	TEC
88	Prep Procurement Pkg for Subcontracting Const	X			X					X
89	Receive Construction Permits	X			X					X
90	Construction Start	X			X					X
91	Initiate Documentation Closeout Process	X			X					X
92	Complete Procurement of Eng. Material (PMM)	X			X					X
93	Prepare Constr. Task Plan and Work Pkg Plan	X			X					X
94	Acquire Temp. Construction Offices & Services	X			X					X
95	Acquiring and moving common use Project Owner Temporary facilities	X			X			X		
96	Acquiring & Moving Temp Construction Facilities	X			X					X
97	Acquire Temporary Office Furniture, Computers	X			X					X
98	Badging, Training of Personnel - Project and Construction Personnel	X			X					X
99	Temporary Facility Construction Permits	X			X					X
100	Coordinate Construction Activities with Ops	X			X					X
101	Waste--remove, package and transport to the disposal facility	X			X		**			X
102	Construction Subcontract Technical Representative Management	X			X					X
103	Review, approve and issue Final Safety Analysis Report (if required)	X			X					X
104	Construction Inspection and Inspection Planning	X			X					X
105	Eqpt Vendor Operating & Maintenance Manuals	X			X					X
106	Dismantling and Removing Equipment required for Construction	X		**	X		**			X
107	Pre-Turnover Maintenance (Stored & In-Place)	X			X					X
108	Develop EAC's	X			X					X
109	Accept Construction Subcontract Work as Mechanical Complete	X			X					X
110	Construction Complete	X			X					X
111	Submit CD-4	X			X					X
112	Start-up Test Plan (Project Responsibility)	X	**		X	**				X
113	Readiness to Proceed	X			X					X
Construction Testing and Project Turnover Activities										
114	Construction Test Procedures and Plans	X			X					X
115	Badging, Training of Personnel for OPC Scope	X			X				X	

		User			Support Org.			Project		
Item	Activity	OPEX	OPC	TEC	OPEX	OPC	TEC	OPEX	OPC	TEC
116	Complete Turnover of First System	X			X					X
117	Component Testing & Checkout – Construction	X		**	X		**			X
118	Electrical Testing (Non Energized Construction)	X		**	X		**			X
119	Electrical Circuit Breaker alignment	X		**	X		**			X
120	Initial Instrument Calibration	X		**	X		**			X
121	Motor/Air Op Valve stroke & limit switch adjustment	X		**	X		**			X
122	Construction Turnover for Operations	X		**	X		**			X
123	Provide As-Built Drawings	X			X					X
124	Correct Design & Construction Related Deficiencies Identified in the System Test	X		**	X		**			X
124	Complete Reviews	X			X					X
125	Lessons Learned Review/Document	X			X				X	
126	Finalize & Submit Project Completion Report	X			X					X
127	Approve for Acceptance Project Closeout	X			X					X
Operations Testing and Readiness Reviews										
128	Establish Joint Test Group (Project User Responsibility)		X		X			**		
129	Operations/Start-up Team Building		X		X			**		
130	Finalize Turnover Plan (Project User Responsibility)		X		X	**			**	
130	Start-up Test Plan for Systems (Project User Responsibility)		X		X	**			**	
131	Write Start Up Test Procedures for Systems (Project User Responsibility		X		X	**			**	
132	Initial Loop Check		X		X	**			**	
	Motor Bump & Run		X		X	**			**	
133	Initial System Cleaning/Flushing/balancing		X		X	**			**	
134	Component Testing & Checkout – Startup/Operation (Project User Responsibility)		X		X	**			**	
135	Start-up Testing By Systems (Project User Responsibility)		X		X	**			**	
136	Operations Startup Test Support/Training (Project User Responsibility)		X		X	**			**	
137	Startup Engineers Testing after Turnover (Project User Responsibility)		X		X	**			**	
138	Perform Post Start-up Turnover Maintenance (Project User Responsibility)	X			X			**		

		User			Support Org.			Project		
Item	Activity	OPEX	OPC	TEC	OPEX	OPC	TEC	OPEX	OPC	TEC
139	Complete Authorization Basis Reviews - (Project User Responsibility)	X			X			**		
140	Write Operations and Maintenance Procedures (Project User Responsibility)		X		X	**			**	
141	Review and Approve Operations and Maintenance Procedures (Project User Responsibility)		**		X					
142	Develop and Write Training Courses		X		X	**			**	
143	Procure Training Materials		X		X	**			**	
144	Perform Operator Training - Instructor Cost		X		X	**			**	
145	Attend Operating Training Courses - Trainee Labor (Project User Responsibility)	X			X					
146	Integrated System Acceptance (ISA) Procedures and Testing		X		X				X	
147	Cold Runs Operations		X		X				X	
148	Readiness Self-Assessment		X			**			X	
149	Conduct ORR		X			**			**	
150	Complete DOE ORR		X			**			X	
151	Prepare Request for Operational Release		X			**			X	
152	Critical Decision-4 submittal and approval		X		X				X	
COMMENCE OPERATIONS - Critical Decision 4										
153	Hot Runs - Operations	X			X			**		
154	Project Financial Closeout	X			X					X

STANDBY

** Member of " Hands On IPT "